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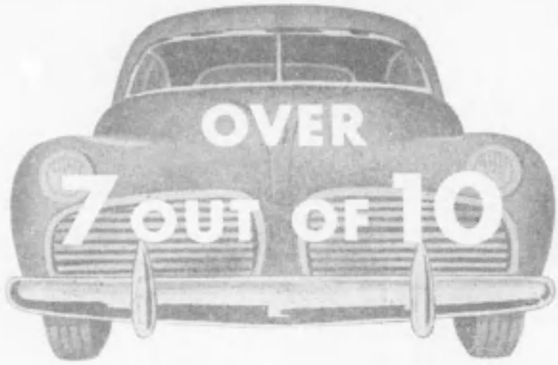
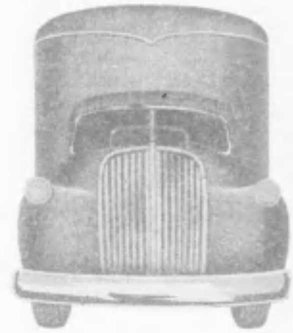


Automotive Vehicles

Ever Built

have been



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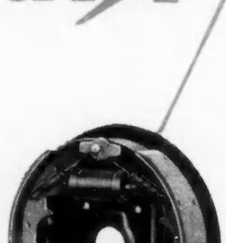

Experience is the reservoir of precedent that holds many of the answers to problems of the future, and makes it possible to avoid errors of the past. The most promising plan can go astray in one tiny error that experience would have forestalled. And in the automotive field—where experience is the keystone of success—Bendix* can point to thirty years' cooperation with a progressive industry.

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Our President Speaks

Cooperative engineering, as promoted and developed by SAE, is more than a phrase. It has proved itself in two wars. It has proved itself in its peacetime contributions to the progress of the automotive industry. SAE has exerted an influence out of all proportion to its years . . . French Lick

In periods of rising expenses, it is mandatory to accomplish more in a given time. It is necessary for both men and machines to produce more. The times put a premium on ingenuity . . . Chicago

No nation can legislate a high and rising standard of living. The only answer is an increasingly efficient use of man-hours in producing goods and services . . . Los Angeles

Automotive engineering increasingly becomes a matter of co-operative effort. Internal-combustion engines, jet engines, diesels, motor vehicles, airplanes – all are assemblies of ideas, designs, processes, work. Many minds have contributed to their present stage of development . . . New York

SAE Tractor & Farm Machinery Engineering Activity has written 11 years of thoroughly constructive achievement into the SAE record, has benefited SAE members, the industry, our national economy . . . Milwaukee

Transportation is the life-blood of this country. Railways, highways, airways, and waterways must be integrated into an efficient and cooperating unit. Were any one lacking the economic structure would suffer . . . Seattle, Wash.

We are having a tough time getting our American way of living back on the rise. Unless and until we practice human engineering, and deal with the spiritual factors involved, production will continue to be something less than 100% efficient. Key to its solution, perhaps, is leadership. We can drive machines. We have to lead men . . . Cleveland

The SAE Technical Board program is most important to automotive progress in years of peace. However, we must continue to fear war. We must not forget to keep our weapons sharp, our country out in front technically and productively . . . Detroit

Prosperity is geared to productivity and always will be. Productivity is the result of intelligent cooperation. Cooperation is essential to a society of high productivity and prosperity . . . Toledo

Times demand that every pound of metal, gallon of gasoline, drop of oil; every tire, every vehicle, every engineer, do a full share of our country's work if we are to maintain and improve our standards of living. To right-thinking men this is no hardship; it is just good engineering . . . San Francisco

Tremendous advances in knowledge made under the driving lash of war now must be cashed for the peaceful use and enjoyment of mankind. The spoils of war, if any, comprise the intensive development and research which, in peace, would have required much more time . . . Portland, Ore.

Scan Futu utl
Progre t F

F. Laverne Miller, F&L Meetings Committee chairman, (left) with SAE Vice-President John C. Geniesse and John M. Campbell, vice-chairman of the F&L Activity Committee photographed during the SAE National Fuels & Lubricants Meeting, Nov. 7 and 8, at Tulsa

Dynamic quartet, this group of Mid-Continent Section officers was largely responsible for the great success of the National F&L Meeting in Tulsa. Left to right: G. W. Cupit, Jr., secretary; B. I. Scoggin, Jr., vice-chairman; R. E. Edwards, treasurer, and Chairman E. W. Cave

ENRICHING experience, at times bordering the emotional, yet highly productive of technical knowledge and engineering cooperation describes as adequately as word and phrase permit the SAE National Fuels & Lubricants Meeting in the Mayo Hotel at Tulsa, Okla., Nov. 7 and 8.

On the bread-and-butter level, the meeting contributed substantially to technical progress in improved matching of fuels and lubricants to engines, established conviction that diverse and equally important steps lead to that complete compatability which means operating efficiency.

On the human interest level, the meeting presented a terrifyingly frank perspective of civilization, at long last possessed of atomic energy, standing at the disjunction of paths which can lead to comparative Utopia or to utter destruction.

Again, SAE members figuratively rode the roaring track with a famous race driver, discovering from the trenchant word and vivid pantomime with which he recreated the 500-mile classic of 1932 and the flight of his machine over the wall on the tricky north turn at Indianapolis, that of such things as flirtation with death is automotive engineering progress made.

Registration soared to a new record above 400. SAE Vice-President J. C. Geniesse cooperated with Chairman F. L. Miller and his F&L Activity Meetings Committee in development of the program, while the Committee on Arrangements, headed b J. H. Baird handled the operation of this mos successful gathering. Serving with Mr. Baird wer W. F. Lowe, J. V. Brazier, and B. I. Scoggin, Jr The cooperating officers from the Mid-Contine Section were Section Chairman E. W. Cave, B. I Scoggin, Jr., vice-chairman, R. E. Edwards, trea surer and G. W. Cupit, Jr., secretary.

Six sessions were spaced over the two days i such way that attending members enjoyed full op portunity, which did not escape them, to join i informal discussional groups at the end of ever formal gathering. Social hours sponsored by th SAE Mid-Continent Section each afternoon pu members in proper mood for well-attended dinner and for evening sessions which equalled in popu larity and audience enthusiasm those of morning and afternoon.

Discussion of atomic energy by a scientist wh participated in its development – Dr. H. B. Hass produced a noticeably stunning effect upon engi neering minds. Thoughts of the new power sourc lingered throughout the meeting and tempere ideas of the future.

"This greatest discovery in the history of phys cal science," said the head of Purdue's Departme of Chemistry, "is either the greatest blessing or th greatest curse man has ever received from th scientists. It can lead to a civilization compare

utlook, Today's
t F&L Meeting

Capt. George Edward Thomas Eyston, of London; Wilbur Shaw, president, Indianapolis Motor Speedway Corp., a dinner speaker, and J. H. Baird, Friday dinner chairman

with which all civilizations to date will seem crude. Or we can have wars which will make World War II look like a Sunday-school picnic.

"No scientist has expressed confidence, in view of the tremendous heat and energy of the atom bomb, in any physical defense. No third bomb was necessary at Bikini to prove that armies and navies are obsolescent. All you have to do is get an atom bomb within half a mile of a ship – and you might as well have no ship.

"I can see no escape from the conclusion that possession of the atomic bomb means world government. I think we should put every means of pressure on Russia, short of nothing whatsoever, to set up world government. Scientists guess only five years from August, 1945, before any nation wanting them can have atomic bombs. Time is running out."

Explaining that the most important aspects of atomic energy have not yet been recognized, and that uses can be so numerous and diversified as currently to defy comprehension, Dr. Hass asserted that atomic energy still is so close to realities that it could compete with coal today, particularly for consumption at distances from fuel sources.

"Atomic energy for motor vehicle propulsion still is in the Buck Rogers stage," he explained, "but I'm not going to say that automobiles won't eventually be driven by atomic energy. We can have atomic energy locomotives within three years. We will have ships propelled by atomic energy. The idea of building a navy to burn oil is about as silly as the idea of having a navy.

"People in this room will live to learn what the first expeditions to Venus and Mars discover there. It is feasible, in the relatively near future, to establish new satellites of the earth, aerial platforms for observational purposes."

Dr. Hass expressed the opinion that uses for atomic energy more important than power production would be found in fields of science such as chemistry and medicine, adding that the possibility of making every element radioactive already is contributing greatly to progress in medicine and, through various effects, creating new concepts of the human body and its ills. He suggested that the present supply of plutonium is sufficient to produce atomic energy for 600 years, plutonium deposits exceeding those of lead, and predicted that other sources will be found; also that the amount of energy created by destruction of the atom will be increased.

"Atomic energy necessitates thinking in new and larger figures," he explained. "If all the hydroelectric plants in the United States last year had been destroying material to produce energy, they would have needed only about eight pounds."

Lingering thoughts of what atomic energy might accomplish, either constructively or destructively, influenced but failed to detract from the businesslike manner in which SAE members at the meeting tackled current engineering problems related to fuels and lubricants and their utilization in modern engines. The beneficial effects of adequate crankcase ventilation and of suitable filters upon the maintenance of satisfactory lubrication competed for interest with announcement of the development of two new instruments for knock-rating motor fuels and reports of the results of cold-weather testing of gasolines. Recommendations were made that crankcase ventilation, temperature control, and filtration are as essential to satisfactory lubrication as proper selection and refining of lubricants and the use of additives.

Review of the 25-year history of the bouncing pin method of knock-rating fuels and disclosure that two new instruments for the same purpose have adapted electronics to work heretofore assigned to acoustics, led to expression of opinion that the time has come for engineers to decide whether a little black box satisfactorily can be sub-

stituted for human ears in detecting the knocking tendencies of automotive fuels; whether man or engine shall determine which fuel should be used.

Availability of pour depressants in the form of additives which keep lubricants liquid in sub-zero weather, and development of pour stability tests for determining pour reversion, or the tendency of lubricants to solidify, were reported in a joint paper by J. G. McNab, A. E. Michaels, and D. T. Rogers, of Standard Oil Development Co., and C. E. Hodges, of Standard Oil Co. of New Jersey.

The pour depressants were said to facilitate utilization of paraffinic-base crude oils in the manufacture of winter-grade lubricants. The pour stability tests were described as making it possible to ascertain in advance which oils will remain fluid in storage at all times, which may become solidified at critical temperatures.

Engineers discovered that in crankcase ventilation, the customers, whether by chance or by plan, had ascertained for themselves that adequate removal of inert gases makes for cleaner engine operation by curtailing the formation of varnish and sludge, preventing corrosion. H. L. Moir and H. L. Hemmingway, of The Pure Oil Co., described findings in a consumer survey which revealed that motor vehicle operators have built and applied numerous different devices for ventilating crankcases and appear to be convinced that these home-made "gadgets" produce results which suggest the advisability of designing and building crankcase ventilation into engines at the factory.

Discussion developed that the need for crankcase ventilation had been recognized as early as 1908, when a pressure-type system was patented, and that the problem was given some attention by automotive engineers in 1924. It was pointed out that the combustion process necessarily creates physically-changed and undesirable products which, with blowby gases, enter the crankcase and cause the formation of sludge and varnish customarily ascribed to deficiencies in lubricants. While resort has been made to changes in oil-refining methods and the utilization of additives, it was explained, the trouble now appears basically to be one of engine design and possible of correction, even when straight mineral oils are used, through crankcase ventilation, temperature control, and proper filtration.

Suggestion was made that the development of adequate crankcase ventilation is an engineering job and that fuels, lubricants, type of engine, operating conditions, and prevailing weather all must be taken into consideration. The idea was described as a device which properly would scavenge the crankcase at all engine speeds by introducing a large volume of air, estimated at 5 to 10 cfm, at low velocity, and which itself would require little or no maintenance. Laboratory and consumer tests were reported to have afforded convincing evidence that even reasonably efficient crankcase ventilation tends to extend operating periods, to reduce valve chamber deposits, and to eradicate or minimize difficulties with sludging and corrosion.

The 25th anniversary of the bouncing-pin method of knock-rating automotive fuels provided opportunity for T. A. Boyd, of Research Laboratories Division, General Motors Corp., to describe the development of the device from its inception as a "diddle-pin" described at an SAE meeting in 1921 by Dr. H. C. Dickinson, then of the Bureau of Standards, and subsequently improved to the point of becoming quantitative and achieving universal use. (See SAE Journal, November, 1946, p. 55.)

Development of the "Sperry Knockometer," incorporating qualities of accuracy, dependability, convenience, reproducibility, and simplicity of operation, was described by P. J. Costa and J. W. Wheeler, as making possible the detection of knocking tendencies of fuel in an engine by combining principles of electronics and of the physician's stethoscope. Errors customarily ascribable to human factors, such as faulty hearing, are eliminated, the Sperry Gyroscope engineers said, by automatic adjustment of the instrument to engine-operating conditions, by removing all except one control to prevent tampering by providing for automatic calibration with age, and by perfecting the device to the point of registering only those knocks traceable to fuels.

Electric Detonation Meter Described

Another new electric detonation meter which, in effect, applies principles of electronics to the bouncing-pin indicator, was reported by D. R. deBoisblanc and H. M. Trimble, of Phillips Petroleum Co. They said the device duplicates the desirable features of the prototype by providing an equivalent electrical network which embodies all the main operational features. Comparative tests of the meter and the bouncing-pin indicator were said to have revealed that the "Phillips Detonation Meter" produces results which are closely parallel and reproducible, with the further possibility of using the new instrument over the entire range of the ASTM knock test method with a single, instead of multiple, standardization.

The new instruments were welcomed by engineers who insisted that the human ear is not reliable in registering knocks and who declared that these developments, in effect, enable the engine to express its own opinion as to which fuels it wants. The intensity of "audible knock" was characterized as a will-o'-the-wisp variously heard by different persons, and even by the same persons, at different times and under different conditions, with the result that the same fuels can be, and frequently are, variously rated. Suggestion was made of the desirability of correlating laboratory and road tests of automotive fuels, since the average motor vehicle and its fuel seldom are used under conditions approaching those of the laboratory.

SAE Vice-President J. C. Geniesse, who was dinner chairman on Thursday, cogitates informal remarks being made by Dr. H. B. Hass, head of the Chemistry Department, Purdue University, who was dinner speaker

Divergent thought was injected in the form of a prepared discussion by George Atwell Richardson, of Metlab Co., recalling the proposal made about 1921 by Edward Adams Richardson for a basic theory of gaseous combustion which, considering molecular reactions and the kinetic theory of gases as extended to cases of disequilibrium such as flame fronts, was said to point a detour around knocking difficulties by utilizing the principle of fuel injection. It was said that the theory of detonation waves, as well as the responsibility of self-ignition for minor knocks, definitely has been established by the high-speed photographs made by Cearcy D. Miller in his work with the National Advisory Committee for Aeronautics.

Cold Separates Additives

Cold-weather operational tests of aviation engines were reported by William L. Hull, of University of Colorado, and Norman A. Parker, of University of Illinois, to show that the "break temperature" of a fuel, or the degree point at which more fuel must be supplied to maintain power output, definitely is a function of fuel volatility. They added that the tests further disclosed that neither tetraethyl lead nor ethylene dibromide, the customary fuel anti-knock additives, necessarily follows gasoline into the cylinders, a phenomenon which could explain the varying lead deposits in cylinders and differences between cylinders in detonation intensities.

Comment was made that these findings, resulting from tests inaugurated to aid the military, which was having seriously embarrassing difficulties with the engines of planes operating in the colder theaters of war, tend to confirm long-held suspicions as to unsatisfactory fuel distribution and spark plug failures, particularly when highly-leaded fuels are being used.

From J. T. Hendren came the report of large-scale operational flight tests of aviation oils as part of a continuing search for lubricants which will meet the critical needs of present and prospective high-output aviation engines. The Pan American World Airways tests, begun in 1942 with entire company divisions participating in order to put the project on an operational scale, revealed that premium-quality aviation lubricants essentially are similar in their ability to lubricate aircraft engines adequately, but differ in their capacities to prevent engine deposits. Detergent-dispersant oils were said to show no appreciable improvement over high-quality straight mineral oils in reducing engine deposition, although they contribute to engine cleanliness in operations involving low cruising horsepower flights with frequent landings and take-offs, and in high cruising horsepower flights. Conclusion was reached that currently-available oils serve basic operating requirements, but that continued improvement in the refining of lubricants could contribute to extension of overhaul periods, ceiling on which has not yet been reached with straight mineral oils.

Discussion developed the helpfulness of flight tests on an operational scale, as well as proposals that data obtained from such complicated and expensive projects be shared generally. It was pointed out that, with many different airlines operating different equipment under different conditions, it is becoming physically and economically impractical to supply the various oils, particularly at price levels attractive to airlines purchasers.

Explanation was given that airlines could be disinclined to pay higher premiums for lubricants which, while meeting optimum requirements, would provide operational advantages insufficient to justify the higher cost. Further, it was said, the demand for aviation lubricants promises to be no more than 300 barrels daily, representing consumption so meagre as scarcely to support the sizable development costs arising from necessarily extensive and expensive bench and flight testing.

It was suggested that isolation of the parts of aircraft engines highly sensitive to inadequate lubrication would permit laboratory work to be carried on in stages with the result of the ultimate solution of such separate problems as ring sticking, piston lacquering, and valve guide corrosion.

Operation of air transportation on an international scale was said to increase the difficulty of supply lubricants which meet the requirements of all the different foreign and domestic airlines with their endless variety of equipment. It was proposed, as a step toward solution of this complicated problem, that information test data be pooled and correlated so that petroleum scientists more readily

continued on page 97

POSTWAR STEEL[S] OF[F]... NEW DESIG[N]...

CONSISTENTLY superior combinations of strength and toughness in steels lie ahead as the result of intensified cooperative research work done during the past few years in connection with the World War II armament production program. Thus, improvements in design and performance of machines are in the offing.

Despite the mass of new information developed during recent years, the general formula for selecting steels remains the same:

The proper material is the one which gives satisfactory performance at the lowest ultimate cost. Each of the factors in this formula is complex, however, and requires re-evaluation in the light of new technical information and economic changes.

Ultimate cost refers to the cost of finished parts rather than of raw materials. Steels of equivalent hardenability may vary considerably with respect to such fabricating costs as forging, cleaning, annealing, machining, heat treating, straightening, and inspection.

The uniformity with which a material responds to processing is important because of increasing labor costs. A simple illustration of this may be found in certain parts which may be made of either a waterhardening or an oil hardening steel. In some cases such parts have been hardened in water with some distortion and risk of quench-cracking to take advantage of a lower price of raw material. Oil hardening may result in the saving of work which would otherwise be expended in inspection, salvaging and rejections to an extent which will more than compensate for the initially higher cost of the oil hardening steel.

Conserving alloying elements was the pressing need responsible for an important phase of the wartime work on alloy steels. Nickel was the first acute shortage. This was met in May, 1941, by substituting nickel-free SAE steels for the nickel-containing SAE steels. By December, 1941, shortages had developed in chromium and then in molybdenum and restrictions were placed on the use of these elements as well as nickel. This led to the development of the "triple alloy" NE (National Emergency) steels, and a list of such steels was published widely in January, 1942.

Guiding principle in developing NE steels was that steels of equivalent hardenability could be used interchangeably. The program therefore involved a great deal of work on hardenability. Fortunately a good start had been made before the war along two important lines: standardization of hardenability testing, and calculation of hardenability from chemical composition and grain size.

Hardness has been defined broadly as resistance to deformation. In the common Brinell and Rockwell tests the measure of hardness is resistance to permanent deformation by indentation. In ductile steels there is a rather definite relationship between indentation hardness values and tensile strength (tensile strength in pounds per square inch equals 500 x Brinell hardness). Indentation hardness tests furnish a similar though less accurate indication of endurance limits as determined in rotating beam tests, since the endurance limit is usually from about 40 to 65% of the tensile strength. Without additional information of some sort, the indentation hardness tests furnish no information regarding ductility or toughness.

These hardness values are not sufficient indications of wear resistance or machinability unless other facts are known. But in spite of these shortcomings, hardness tests are frequently the only tests of a metallurgical nature specified for finished parts. Justification for this practice lies in the fact that additional information is available regarding the composition and heat treatment of the part. Microstructure furnishes further but still incomplete information regarding such characteristics as toughness and machinability.

Prior development of the Jominy end-quench

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*"A Postwar View of Alloy Steels," by Robert S. Archer, Climax Molybdenum Co., was presented at SAE Summer Meeting, June 5, 1946.

EL OFFER
G OPPORTUNITIES

Excerpted from a paper by **Robert S. Archer***

test proved to be a most important factor in this program. Hardenability testing was not new, many consumers of steel having regularly made hardenability tests of some kind. The Jominy test made it possible for the first time to obtain quickly and economically hardenability data applicable to a wide range of sizes. These characteristics led rather quickly to the general adoption of this test in American industry.

Low temperatures are apt to lead to brittle failures. A familiar example of the effect of temperatures is found in the cold shearing of bars and billets. It is general experience that shear cracks occur more frequently in winter than in summer, and when difficult sizes and grades of steel are to be sheared it is common practice to heat them somewhat above normal summer temperatures to prevent cracking. Some failures of automotive parts, such as springs and axles, have been more common in winter than in summer, and are attributed largely to the greater brittleness of the steel at low temperatures, although the service conditions themselves may also be more severe in winter. Railroad rails are often tested for brittleness at low temperatures, and the matter of brittleness at low temperatures has been one of great interest in the aircraft industry. Certain items of military equipment which perform satisfactorily at summer temperatures may be found unsatisfactory because of brittleness at temperatures around −30 F.

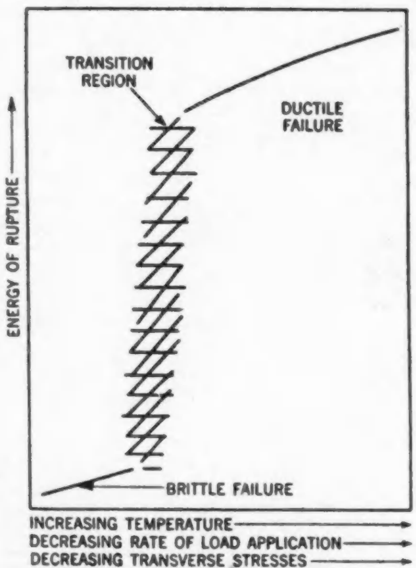


Fig. 1 – Schematic diagram showing effect of temperature of test on notched bar impact values of a non-austenitic steel

Determination of the effects of non-uniform stress distribution on deformation and failure is complex, and does not appear to have been satisfactorily solved even for such an apparently simple case as a notched tensile test specimen. Stress distributions existing during the substantially elastic stage of deformation are greatly altered when even a small amount of plastic deformation takes place. Stress conditions which are conducive to brittle failure have been described in various terms such as stress concentration, transverse stress, biaxial stresses and triaxial stresses. For convenience we refer to any stress condition which promotes brittle failures as "stress concentration." It is impossible to predict quantitatively the effect of stress concentration in an engineering part or structure of complex shape. It is nevertheless valuable to recognize qualitatively the effect of stress concentration on deformation and rupture.

The fact that Charpy and Izod tests are called "impact tests" indicates that they were intended to measure the toughness of material under conditions of impact or high velocity loading. Actually the striking velocity in these tests is quite

low – on the order of 15 ft per second – as compared with velocities frequently encountered in peacetime service, to say nothing of ballistic velocities. Experiments have shown that for many engineering steels the energy required to break the notched impact specimen may be almost the same whether the specimen is broken by slow bending or in the impact machine.

Work done at Watertown Arsenal has led to the conclusion that the effect of increased striking velocity is equivalent to the effect of decreased temperature of test. As an illustration of the magnitude of the effect, Hollomon pointed out that a lowering of temperature by 90 F is equivalent to an increase in strain rate of at least 1000 fold. It is comparatively easy to make notched bar impact tests at low temperatures.

The three important factors which contribute to brittle failures in steel are:

Stress concentration
Low temperature, and
High rate of loading.

Whether or not these three factors are related to each other in an exact manner under all conditions, it is clear that their effects are qualitatively similar. In order to appraise the tendency of steel to fail in a brittle manner it is now considered necessary to evaluate in some way the effects of all of the three factors mentioned. A practical method of doing this is to make notched bar impact tests at as many different temperatures as is necessary to establish a complete impact versus temperature curve as illustrated by the schematic diagram in Fig. 1.

By a complete curve is meant one which shows the transition from tough to brittle fractures which commonly occurs in ferritic steels. At the higher temperatures failure is accompanied by plastic deformation, high energy absorption and fractures which appear fine, silky or fibrous because of the plastic deformation itself. At the lowest temperatures failure takes place with very little plastic deformation, with low energy absorption and with fractures which appear brittle and sometimes coarse because of the absence of plastic deformation. In the intermediate or transition range fractures may exhibit mixed characteristics, and the energy values are apt to vary considerably between duplicate tests.

A high transition temperature range in the impact-temperature curve is conducive to brittle fractures. It indicates that an accentuation of any of the three unfavorable factors is apt to cause failure in a brittle manner. Conversely, a lower transition temperature indicates that the steel is more capable of withstanding any one or any combination of the unfavorable factors. The notched bar impact tests at low temperatures not only indicate the suitability of the steel for service at low temperatures, but also indicate the suitability of the steel under conditions involving high stress concentrations or high rates of loading.

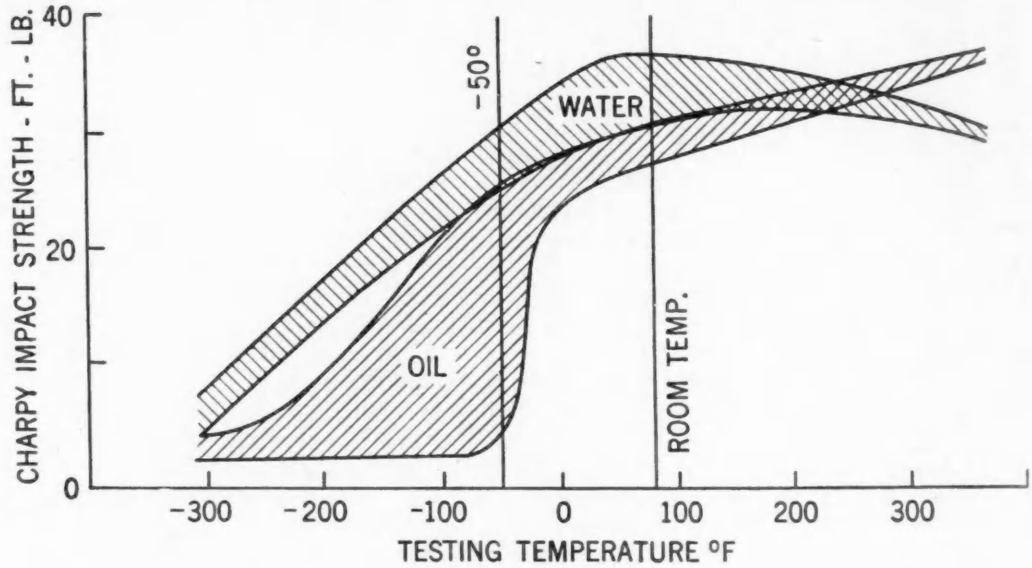


Fig. 2 – Effect of quenching rate and hence of as-quenched structure on the notched bar impact properties of SAE 1045. Effects of free ferrite and pearlite are usually brought out in such test at room temperature. Effects of bainite on toughness is shown by more severe test as by lowered temperatures

The best combinations of strength and toughness are generally found in steel which has been tempered after having been hardened to a fully martensitic structure. When fully martensitic hardening is not obtained, the nature and distribution of the non-martensitic constituents are important. In steels of low and medium carbon content these constituents are ferrite, pearlite and bainite. Two types of bainite may be distinguished – upper bainite, formed at temperatures just below the lowest temperatures at which lamellar pearlite can form, and lower bainite, formed at temperatures just above the Ms point or temperature at which martensite begins to form.

Ferrite, Pearlite Are Detrimental

With respect to toughness after tempering, ferrite and pearlite are most detrimental. Free ferrite at grain boundaries is particularly detrimental at high hardness levels of the steel as a whole, on account of the marked contrast in strength between the ferrite and the interior portions of the grains. The ferrite will not withstand sufficient stress to plastically deform the harder constituents. Upper bainite is in general less detrimental than ferrite or pearlite, and lower bainite may after tempering be very nearly as tough as tempered martensite.

The effects of free ferrite and pearlite are usually brought out by notched bar impact tests made at room temperature, while the effects of bainite on toughness may be revealed only when the severity of the test is increased as by lowering the temperature of testing, Fig. 2.

The decision regarding the type of structure needed in the finished part involves a number of considerations. First perhaps is the question whether the service conditions are such that the best possible combination of strength and toughness is required in the part as a whole. In some cases it might be concluded that optimum properties are required at all free surfaces or at some point of critical stress, but are not required in the center of the section.

Boegehold has published a curve which suggests that for best properties after tempering the hardness as quenched should be not more than about ten points Rockwell C below the maximum hardness obtainable for the carbon content of the steel under consideration. This would correspond for most grades to structures containing minimum amounts of martensite from about 85 to 95%.

Determines Suitability

The development of the H (hardenability) steels recognizes current opinion that the first consideration in the selection of an alloy steel is that it must have a degree of hardenability suitable for the intended application. The H steels, based on standard SAE or AISI analyses, guarantee a definite "band" of hardenability for each grade. The type of steel is specified as formerly by chemical analysis, but slightly wider ranges are permitted in view of the recognition that small variations in composition are not important providing hardenability is maintained within the desired band. It has long been a practice for steel producers to submit to consumers for approval "off-heats" of this type, and in general to receive approval. To decide whether an off-heat was suitable for a given application required the attention and judgment of both producer and consumer. The development of the H steels offers the advantages that some of the heats which would otherwise require special consideration can be handled in a routine manner, and that such heats comply with the original specifications.

Just how closely hardenability needs to be controlled depends on the intended use of the steel. In general, however, the consumer desires that the hardenability bands be as narrow as it is practicable for the steel producer to make them. By using the information now available regarding the quantitative effects of the various elements on hardenability, it is possible to calculate hardenability bands corresponding to the extreme variations in chemical analysis permissible for a given grade of steel under standard specifications. It is recognized that theoretical bands calculated in this manner are too wide for a great many applications. It is also recognized that it is not likely that many heats of a given grade will have all of the hardening elements on either the high side or the low side at the same time. To determine how narrow the hardenability band may be made without encountering an undue percentage of heats which are outside the band will require extensive experience in the production of the H steels so that adequate statistics can be accumulated.

Triple Alloys Evaluated

A question which has often been discussed since the end of the war concerns the merits of the NE "triple alloy" steels in comparison with the old SAE grades. The three alloying elements indicated by the term "triple alloy" are chromium, molybdenum and nickel. Substantially all of the molybdenum and nickel contained in scrap is recovered on remelting by any process, and some of the chromium is recovered on remelting, especially in the electric furnace process. Presumably, vanadium was not included in these steels because it was scarce and because of the fact that it is not recovered in tonnage melting processes. Chromium-molybdenum-nickel steels are not new, since these elements were used in combination with each other for many years before the war. Formerly, however, these three alloying elements were generally used together only when fairly high hardenability was required. The novelty about the NE triple alloy steels is that chromium, molybdenum and

concluded on page 46

Soil Shear Is Key to

TO learn why and how soils behave as they do in bogging down track-laying equipment during military operations, Army Ordnance engineers have been conducting studies of soil physics in both the laboratory and the field. Soil shear characteristics wield an important influence on vehicle mobility, they find.

In their efforts to arrive at a rational basis of providing for efficient operation under all conditions on all types of soils, Ordnance engineers are being assisted by the Controlled Soil Testing Committee of the SAE Tractor Technical Committee.

From a consideration of only those factors influencing traction (not relating effects of flotation, the other element involved in vehicle mobility), the following tentative conclusions were drawn:

1. Traction is influenced more by soil shear strength than by any other soil property;

2. Track cleaning ability may not be too important;

3. Traction on light sandy soils (agricultural soils, not beach sands) is unaffected by moisture content below the saturation point. Moisture content of plastic soils greatly influences traction;

4. Increase in traction is not proportional with increased weight of the same vehicle.

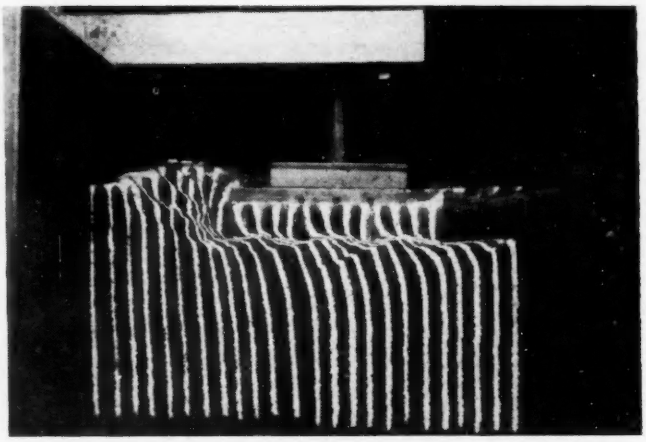


Fig. 1 – Norfolk Sand being tested with a model track and grousers is shown to have a horizontal shear plane

Although problems of military vehicle mobility begin where agricultural problems end, the tractor industry and tractor users may find results of this work interesting.

Since former empirical methods of improving vehicle mobility failed, the problem was approached by studying physical characteristics of soils and developing a means to control them or to overcome their deleterious effects. Three types of soil representative of a wide range were used – Davidson Loam, Norfolk Sand, and Cecil Clay.

Shear was suspected as being an important soil property relative to mobility. Basic data defining the nature of shearing action in soil under a slipping track were lacking. Laboratory apparatus, shown in Fig. 1, was developed for observing this action. It consists of a box arranged to move horizontally relative to fixed models of track plates and grousers. Vertical movement of the model-holding fixture permits loading simulating ground pressures.

By means of white lines – formed by filling punched holes in the soil against the glass window with marble dust – soil movement can be observed and photographed. These tests reveal that the ultimate shear plane in confined soil, as under a track with grousers, is substantially in a horizontal plane. Fig. 1 demonstrates this for Norfolk Sand.

For studying shear strength, the laboratory equipment shown in Fig. 2 was developed. The soil sample is placed in two mating blocks, each with a 2.52-in. diameter hole. A load giving the desired vertical pressure is applied. Shearing of the soil column is accomplished by movement of the lower block and maximum shear value is read on an indicator.

From these tests it was learned that shear strength of nonplastic soils such as Norfolk Sand does not vary with moisture content in the unsaturated state. Shear strength of plastic soil such as Davidson Loam increases with moisture content to a point near the lower plastic limit and rapidly decreases beyond this point.

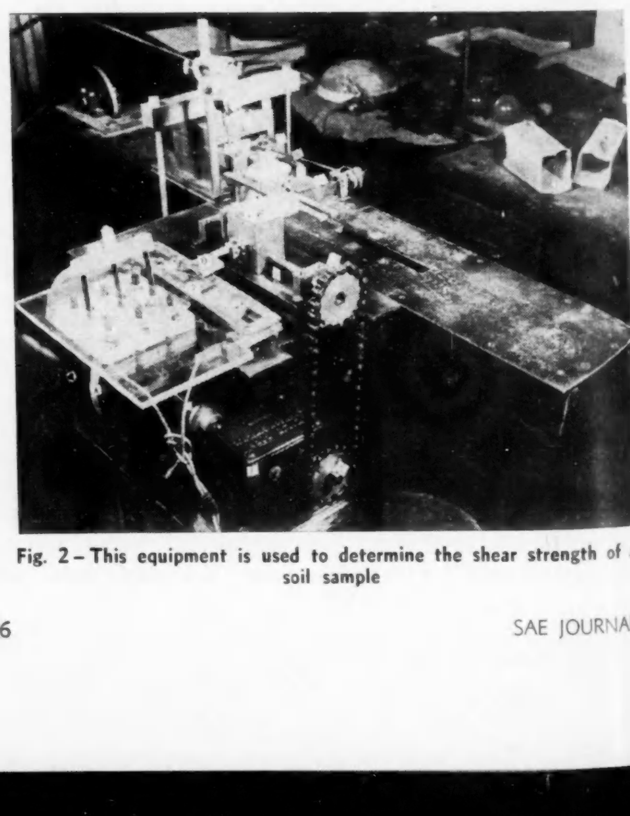


Fig. 2 – This equipment is used to determine the shear strength of a soil sample

Key to Army Vehicle Traction

From a paper by

W. A. Gross, Jr. and A. D. Elliott*

It was also found that shear in nonplastic soils increases as a straight line function of a vertical load but is not proportional to vertical load in plastic soils. This phenomenon for the two soil types is charted in Fig. 3.

Maximum shear of plastic soils has been shown to be proportionate to the plastic number. Since heavier clays have the largest plastic range, shear values are greater than those of lighter loams and sandy soils.

These laboratory tests proved soil shear values particularly significant in the study of the traction factor in vehicle mobility in that:

1. Maximum shear strength of plastic soils occurs at approximately the lower plastic limit;
2. Shear strength of plastic soils is proportional to the plasticity number;
3. Shear strength of nonplastic soils is proportional to the plasticity number.

To relate laboratory shear test results to vehicle operation, tests were conducted in concrete bins containing a known soil type. Static drawbar pull over a wide range of moisture contents was determined by locking the vehicle tracks and measuring with a dynamometer the amount of pull required to shear the soil under the tracks. Resulting data patterned laboratory soil shear values.

Dynamic drawbar pull, obtained in normal vehicle operation on plastic soils, is shown in Fig. 4 to decrease rapidly with increase in moisture content below the plastic limit. These data indicate that for this vehicle, additional mobility might be gained by modifications of suspension elements – yet to be determined – as they affect application of the track to the ground.

For example, if performance would be increased to that indicated by the static drawbar pull curve in Fig. 4, vehicle drawbar pull would be increased from approximately 1600 lb to 2800 lb in the region of 16% moisture.

Relation of traction efficiency to vehicle weight of a light cargo carrier based on laboratory measurement of soil shear is shown in Fig. 5. In this case the decrease is probably due to overloading the suspension elements since normal weight of this vehicle is under 5000 lb. Considerable track action producing track wave and track plate buckling was observed during these tests.

Although not entirely conclusive, some evidence of relationship between track performance and track shear area was found. It came to light in a comparison of static drawbar pull measurements of a light tractor with two sets of tracks – one with

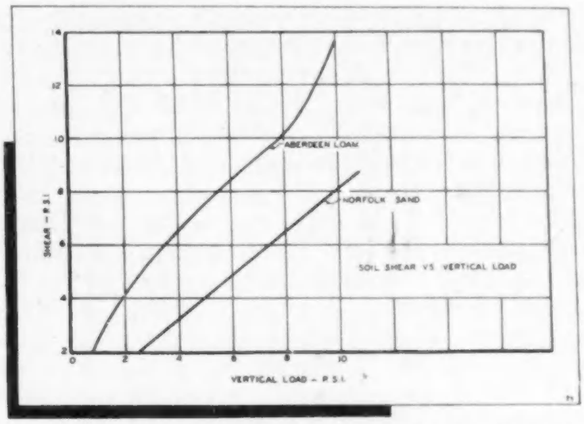


Fig. 3 – Shear in nonplastic soil (Norfolk Sand) varies as a straight line function of the applied vertical load, but shear in plastic soil (Aberdeen Loam) does not

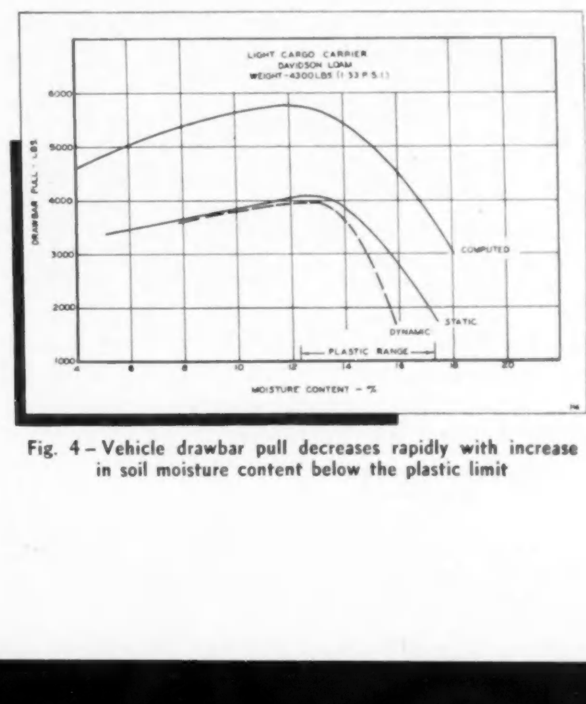


Fig. 4 – Vehicle drawbar pull decreases rapidly with increase in soil moisture content below the plastic limit

* Paper "Traction as Influenced by Soils and Their Condition;" by W. A. Gross, Jr., and A. D. Elliott, Ordnance Research and Development Center, was presented at SAE National Tractor Meeting, Sept. 12, 1946.

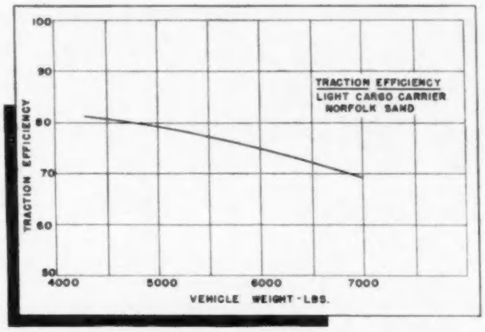


Fig. 5 – In one series of tests using a light cargo carrier, traction efficiency decreased with an increase in vehicle weight

1⅝-in. high grousers and the other with ⅞-in. high grousers.

Results from the Davidson Loam Course showed the maximum drawbar pull to be approximately 7% less with the low-grouser track than with the high-grouser track. The 7% reduction in drawbar pull more nearly approximates the 10% difference in shear area than the 46% difference in grouser height. Duplicate tests in Cecil Clay show the same results.

These field tests also indicate that track shear area is more important in producing traction than is grouser height. Since shear area increases more rapidly with increased track width than with increased grouser height, the data suggest a possible design trend for improving traction in soil types used for these tests.

The fact that increased grouser height does not produce a proportionate increase in drawbar pull may bear some relation to the zone of compaction pattern in soil resulting from vertical weight on the tracks. When load is applied to a flat surface on compressible soils, the resulting pressures in the soil have a parabolic pattern. The pressure bulb takes the form shown in Fig. 6.

Volume of the compressed soil included between points of zero pressure and the bearing surface is

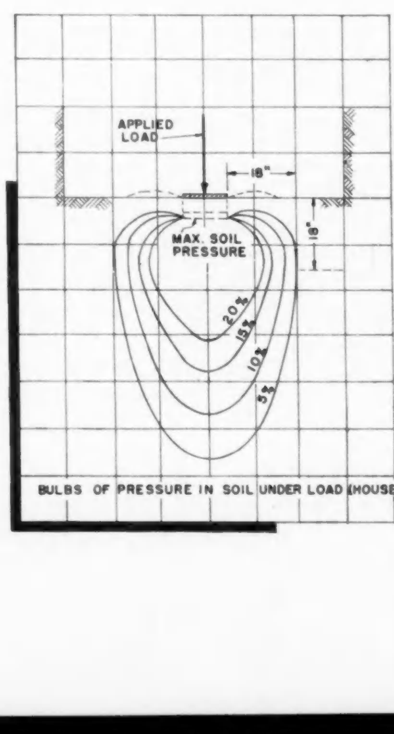


Fig. 6 – Soil volume within the lines of zero pressure and the bearing surface is the mass that supports the load

the soil mass which furnishes support for the load. Resistance to deformation offered by the soil's cohesion and internal friction develops the bulb's supporting power. In the light of this theory it may be possible to extend grousers beyond the range of greatest compaction resulting from vehicle weight, thus shearing soil of lower shear resistance.

To study the reaction of soil to grouser movement behind a slipping track, laboratory equipment was developed. It consists of a soil box with a glass viewing window and a means of forcing models of grousers into the soil with the bottom face of the grouser in contact with the specially prepared surface of the window.

Theoretical analyses of test results using the three typical grouser shapes illustrated in Fig. 7, indicate that the straight grouser is superior to chevron and curved grousers. The chevron grouser causes lines of soil motion to radiate from beneath the track, outside the compacting zone resulting from track weight. This permits the soil sheared

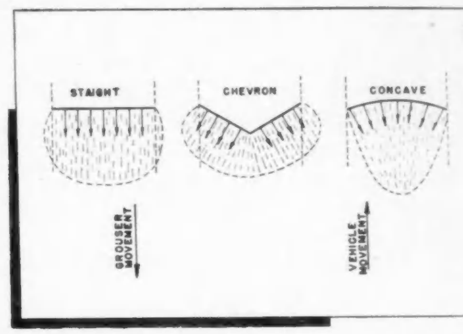


Fig. 7 – These three grouser types were tested and the straight shape was found to be superior to the other two

by the grouser to flow from beneath the grouser, allowing slippage more readily.

In the case of the curved grouser, concave in the direction of slippage, lines of soil motion concentrate toward center of track. They produce a pattern of disturbance more extensive than either of the other two grousers, but soil compaction that resists slippage is not effective behind the entire area of the grouser. The disturbed area in the track center extends beyond the next pitch of conventional tracks. Results indicate that grousers of this form are best suited for long pitch tracks.

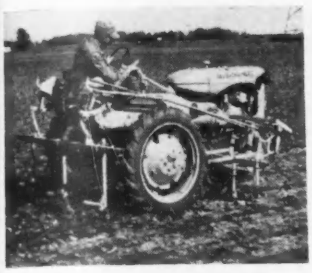
In conclusion it should be emphasized that because of the complex nature of the soil system and the wide variation in characteristics throughout the world, the test results outlined in this article should be considered merely as an introduction to vehicle mobility as influenced by soils.

Flotation is so closely related to traction that no conclusions regarding mobility can be undertaken without considering fully both factors and their interrelation with the full range of soil types and conditions.

TRACTORS TO IMPROVE

Despite Farmers' Satisfaction

BASED ON A PAPER BY **C. T. O'Harrow***



NO startling increases in traction or traction efficiency are envisioned for the near future by C. T. O'Harrow of Allis-Chalmers Mfg. Co. for tractors operating on the usual surfaces; only with a few extreme conditions, such as mud, will large-scale improvements be made.

O'Harrow reached this conclusion after an analysis of tractor operation on many different surfaces. He discovered that to attain sufficient traction to transmit large horsepowers at a comparatively low speed – and at high efficiency – is an extremely complex job.

It is for this reason that he expects only small improvements to be made, brought about by the following means:

- Installation of tires of bigger cross-section.
- Installation of drive wheels of larger diameter.
- Reduction of inflation pressure.
- Addition of weight.
- Rearrangement of drive wheels.
- Use of steel tracks.
- Revision of tread design.

Discussion of Methods

The first three methods actually give improved performance because of a resultant increase in the area of tire contacting the ground. These increases, O'Harrow warns, are of most use to the farmer only if made within present tire outlines. Thus the increased performance coming from installing tires of bigger cross-section or wheels of larger diameter must be weighed against the additional cost and space.

*Paper "Traction Efficiency," by C. T. O'Harrow, Allis-Chalmers Mfg. Co., was presented at the SAE National Tractor Meeting, Milwaukee, Wis., Sept. 12, 1946, and will be published in SAE Quarterly Transactions.

At present, O'Harrow points out, the reduction of inflation pressure is of limited use because manufacturers' ratings require an inflation pressure of at least 12 psi, regardless of tire size or load. O'Harrow believes this figure should be reexamined as new tire constructions and materials are introduced.

If improvement is sought through the use of added weight, the author says it must be easily removable, as an increased efficiency results from adding weight only at loads of at least two-thirds maximum drawbar pull. The farmer can't afford to spend a lot of time adding or removing weight to obtain relatively small improvements in traction efficiency.

One rearrangement that has given better efficiency than the usual two-wheel drive is the use of tandem drive wheels. O'Harrow believes the better performance is due to the fact that the rear wheels can make use of some of the work done on the soil by the front drive wheels.

Steel tracks give better traction performance than the tandem arrangement.

Engineers should pay particular attention to efficiency at about one-half maximum drawbar pull in developing new tread designs, the author says, because the farmer operates his tractor at this load most of the time.

Farmer Satisfaction

O'Harrow points out that the farmer is already well satisfied with the ability of his rubber-tired tractor to develop the required pull and drawbar horsepower on the surfaces he generally encounters – and at a reasonable fuel consumption, the farmer's measure of economy. It is the engineers that aren't satisfied. They feel that there is still some room for development.

For instance, traction efficiency and traction are greatly affected by variations of soil, so that O'Harrow sees value to be derived from a study of the physical characteristics of soils as related to the action of traction devices.

GARAGE LAYOUT for TRUCK FLEET

BASED ON A PAPER BY

ELLIS W. TEMPLIN*

ECONOMICS play an increasingly important role in fleet operation, and the new buildings of the Los Angeles General Plant Division have been carefully planned with the long term outlook in mind.

Proper planning of layout to smoothly run vehicles in progression as in a modern mass production assembly line, careful choice of machinery and tools to reduce labor costs, and providing conveniences for workers, are the main considerations of the plans which are expected to be realized in January, 1950.

The fleet is comprised of more than 1200 vehicles ranging from passenger cars to 10-ton trucks and six-wheeled trailers. Construction equipment of the fleet includes compressors, drum hoists, lighting units, pumps, crawler tractors, cable laying plows, and other machinery.

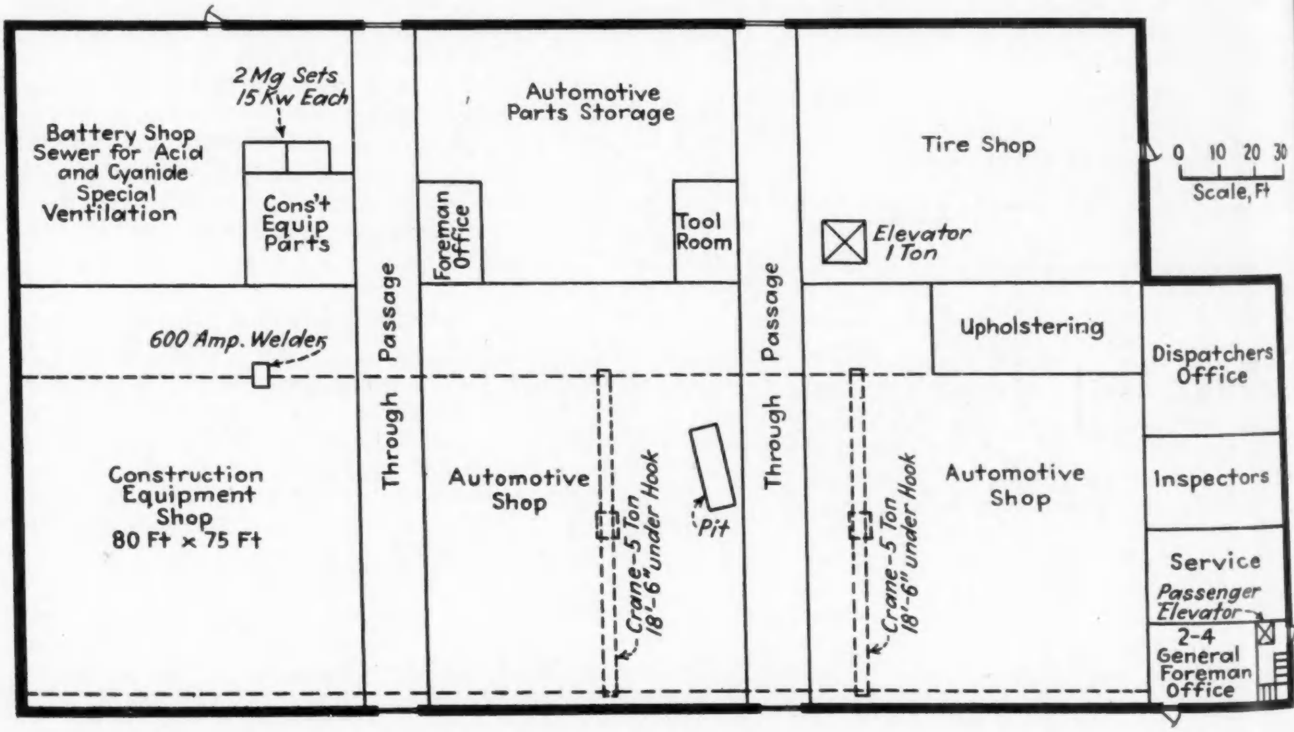
Shop rate calculations and estimates, an essential factor in determining the most economical layout and the most productive equipment, were:

FISCAL YEAR	PER HOUR
1945-47	$2.25
1947-49	2.28
1949-50	2.35
1950-51	2.42

In view of these anticipated increases, hoists were chosen over pits, overhead cranes will be installed, clear and consolidated working space is provided, good heat, light and ventilation will be built into the new facilities, and both chassis and engine dynamometers will be used.

* Paper, "Shop Layout and Equipment for a Large Fleet," by Ellis W. Templin, Los Angeles Department of Water & Power, presented at SAE Summer Meeting, June 4, 1946.

Production line philosophy dictated the basic conception of the Los Angeles Department of Water & Power garage, floor plan shown below. Basement is excavated under tire shop, upper lefthand corner



LAYOUT for BUS FLEET

BASED ON A PAPER BY
P. J. SCHRODT*

BUS OPERATIONS have progressively moved from the hit-or-miss days of the jalopy of a quarter of a century ago, to an exacting business requiring the best of planning to best serve the needs of an exacting public. Today, nothing less than the smooth flow of a production line can be tolerated.

In planning our new garage, we took as our guide the daily operations which are:

Servicing: Gassing, oiling, and cleaning;

Inspections: Greasing, adjustments, and minor repairs;

Major overhauls: Mechanical units, body, and painting, and also kept in mind

Parking.

As buses come through the entrance, they are fueled at the new gas station provided with four lanes. They are driven into an open court to await their turn to be driven into the shop.

Four run-through pits, equipped with grease outlets, await the vehicles in turn. Alongside these has been installed a modern wash rack.

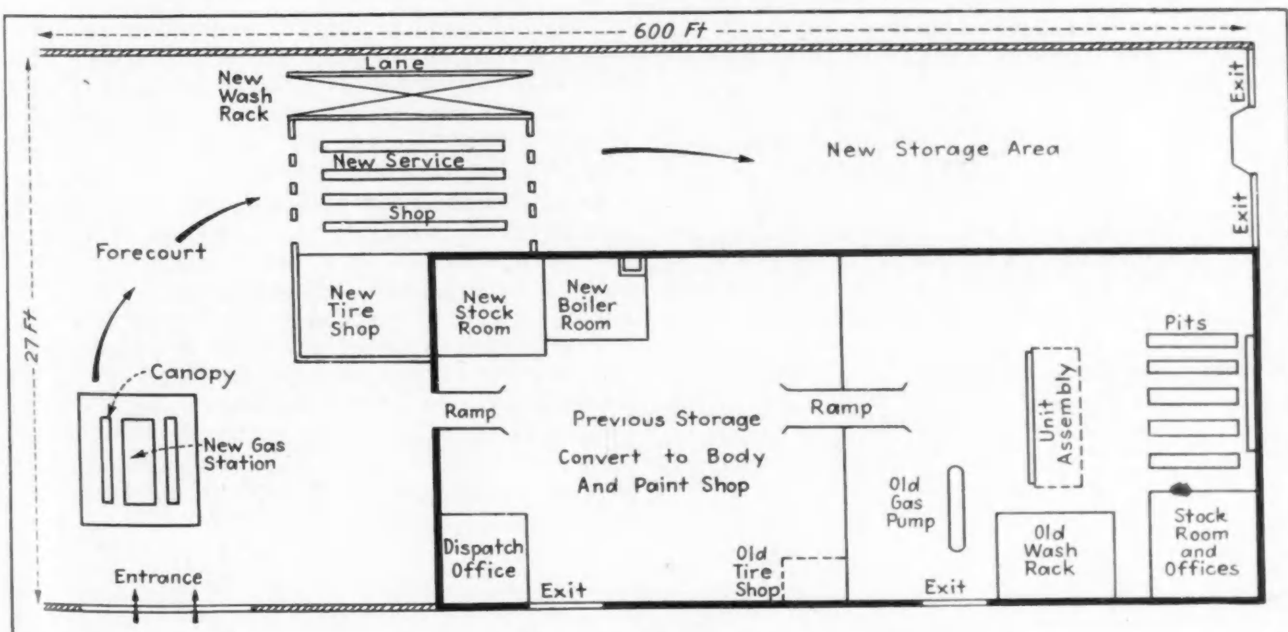
Adjacent to the main service shop are the tire shop, stock room, and wash and locker rooms, and the heating plant. Machine, unit assembly, welding, body, and paint shops are shown below.

The heavy outline shows the old building, of about 180 x 405 ft. We were unable to acquire sufficient land to provide the ideal setup, but achieved the same result with a 5% ramp.

The new 84 x 96 ft service shop has four pits each of which is long enough to accommodate two buses. These are 90 ft long, 4 ft 9 in. deep, 3 ft 6 in. wide at the top and 4 ft wide at the bottom. This extra width provides more working room for the mechanic. Pits are painted light gray enamel and are amply illuminated. Tool box recesses, 10 x 24 in. long, are located inside the pits.

* Paper, "Bus Garage Layout and Design," by P. J. Schrodt, B. C. Motor Transportation, Ltd., presented at SAE National West Coast T&M Meeting, Seattle, Aug. 24, 1946.

Smooth flow of vehicles through this shop simulates mass production assembly shop. B. C. Motor Transportation, Ltd., made optimum use of existing plot and building, with additions to fit needs



Fuel-Air Ratios For Constant

FUEL-AIR ratios required for constant-pressure combustion of lean mixtures of hydrocarbon fuels – corrected for variations in heat of combustion, fuel hydrogen-carbon ratio, and products of previous combustion and water vapor in the inlet air – can now be determined simply and quickly from five charts developed by Newman A. Hall of United Aircraft Corp.

These charts, along with their method of use, are given on pages 34 and 35.

The basic analytical tool used by Hall in developing his charts is the principle of conservation of energy. He simplifies his analysis by considering the entering working medium to be dry air, taking care of other substances in the air by means of correction factors.

Air enters the combustion chamber at a certain mean energy level, which can be measured by the enthalpy (or heat content) of the air at its mean stagnation temperature. The combustion of the fuel releases a net amount of heat, which, when added to the initial energy level, gives the energy level of the products of combustion.

The constant-pressure lower heat of combustion h_{L0} is commonly given with reference to a base temperature of 60 F, so that h_{L0} represents the quantity of heat that must be delivered to a heat reservoir if the fuel is injected in liquid form at 60 F into an air stream also at 60 F, and if, after combustion, the air stream and completely burned uncondensed products are discharged at 60 F and air inlet pressure. Of course if any other initial or final states were used, the heat of combustion would be different.

A hypothetical combustion process thermodynamically equivalent to the actual process is set up by Hall to accommodate this precise definition of the heat of combustion. He assumes that the following steps take place:

1. Reduction of air temperature from an initial value T_1 to the base temperature T_0 with a heat release of $w_a(h_{a1} - h_{a0})$ Btu per sec.

2. Reduction of fuel temperature and state from an initial value T_3 to liquid fuel at the base temperature T_0 with a heat release of $w_f(h_{f3} - h_{f0})$ Btu per sec. The heat of condensation will be included if the fuel is injected in vapor form, unless, as with light hydrocarbons, the heat of combustion is referred to the gaseous state.

3. Combustion at the base temperature T_0 with a heat release of $w_f h_{L0}$ Btu per sec.

4. Heating of the gaseous products of combustion from the base temperature T_0 to the final temperature T_2 with a heat absorption of $(w_a + w_f)(h_{g2} - h_{g0})$ Btu per sec.

If it is assumed that ideal conditions exist, no energy losses will occur and the heat released will equal the heat absorbed, or:

$$w_a(h_{a1}-h_{a0}) + w_f(h_{f3}-h_{f0}) + w_f h_{L0} = (w_a+w_f)(h_{g2}-h_{g0}) \tag{1}$$

Only lean mixtures are considered (as this condition covers most constant-pressure combustion), so that the fuel will be completely burned to carbon dioxide and water vapor and the enthalpy of the products of combustion can be determined by reference to the combustion equation.

For a hydrocarbon fuel C_pH_q the ideal combustion equation is $C_pH_q + (p + q/4)0_2 = pCO_2 + qH_20/2$, which states that in the combustion of one mole of fuel $p + q/4$ moles of oxygen will be removed from the air and p moles of carbon dioxide and $q/2$ moles of water vapor will be added. Since the quantity of any material involved equals the product of the number of moles and the molecular weight, w_f pounds of fuel consumed per second is equivalent to $w_f/(12.01p + 1.008q)$ moles per second.[1] Accordingly, the products of combustion of w_f fuel in w_a air consist of:

$$w_a - w_f \frac{32(p + q/4)}{12.01p + 1.008q} \text{(lb per sec } O_2) + w_f \frac{44.01p}{12.01p + 1.008q}$$

$$\text{(lb per sec } CO_2) + w_f \frac{9.008q}{12.01p + 1.008q} \text{(lb per sec water vapor)}$$

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* Paper "Fuel-Air Ratio Required for Constant-Pressure Combustion of Hydrocarbon Fuels," by Newman A. Hall, United Aircraft Corp., presented at SAE Summer Meeting, French Lick, Ind., June 4, 1946.

[1] The following atomic weights are used: carbon, 12.01; hydrogen, 1.008; oxygen, 16.

essure Combustion

BASED ON A PAPER BY **NEWMAN A. HALL***

Fuel-air ratios can now be determined simply and quickly for constant-pressure combustion. Newman A. Hall of United Aircraft Corp. has developed charts that eliminate the tedious calculations that were formerly necessary to obtain these ratios.

The background of these charts is given here, along with a discussion of how to use them.

Thoroughly practical, the charts correct for variations in heat of combustion, fuel hydrogen-carbon ratio, and products of previous combustion and water vapor in the inlet air. Only lean mixtures are considered as they cover most constant-pressure combustion.

These charts should be particularly useful in gas turbine and jet-propulsion combustion analysis.

The water vapor plus the carbon dioxide less the oxygen required for combustion may be termed the net products of combustion.

In so far as the thermodynamic properties of the working medium are concerned, the combustion of the fuel has the same effect as the addition of a substance in proportion to the mass of fuel having thermodynamic properties the same as the net products of combustion. The enthalpy of a mixture of a gas is the sum of the enthalpies of the several components proportioned by weight. Thus, the enthalpy of the products of combustion will be:

$$(w_a + w_f)h_2 = w_a h_a + w_f h_p \tag{2}$$

where h_p is the enthalpy of the net products of combustion. Referring to the weight breakdown of the combustion process outlined above, it is evident that:

$$h_p = \frac{9.008q\, h_{H_2O}}{12.01p + 1.008q} + \frac{44.01p\, h_{CO_2}}{12.01p + 1.008q} + \frac{32(p + q/4)h_{O_2}}{12.01p + 1.008q}$$

$$h_p = \frac{h_{C_p} + m h_{H_p}}{1 + m} \tag{3}$$

where:

$m = 1.008q/12.01p = 0.0838q/p$ hydrogen-carbon mass ratio for the fuel

$h_{C_p} = \dfrac{44.01 h_{CO_2} - 32 h_{O_2}}{12.01}$ enthalpy of carbon net products of combustion

$h_{H_p} = \dfrac{9.008 h_{H_2O} - 8 h_{O_2}}{1.008}$ enthalpy of hydrogen net products of combustion

The carbon and hydrogen net products of combustion are, respectively, the net products that would occur if the fuel was, respectively, pure carbon or pure hydrogen.

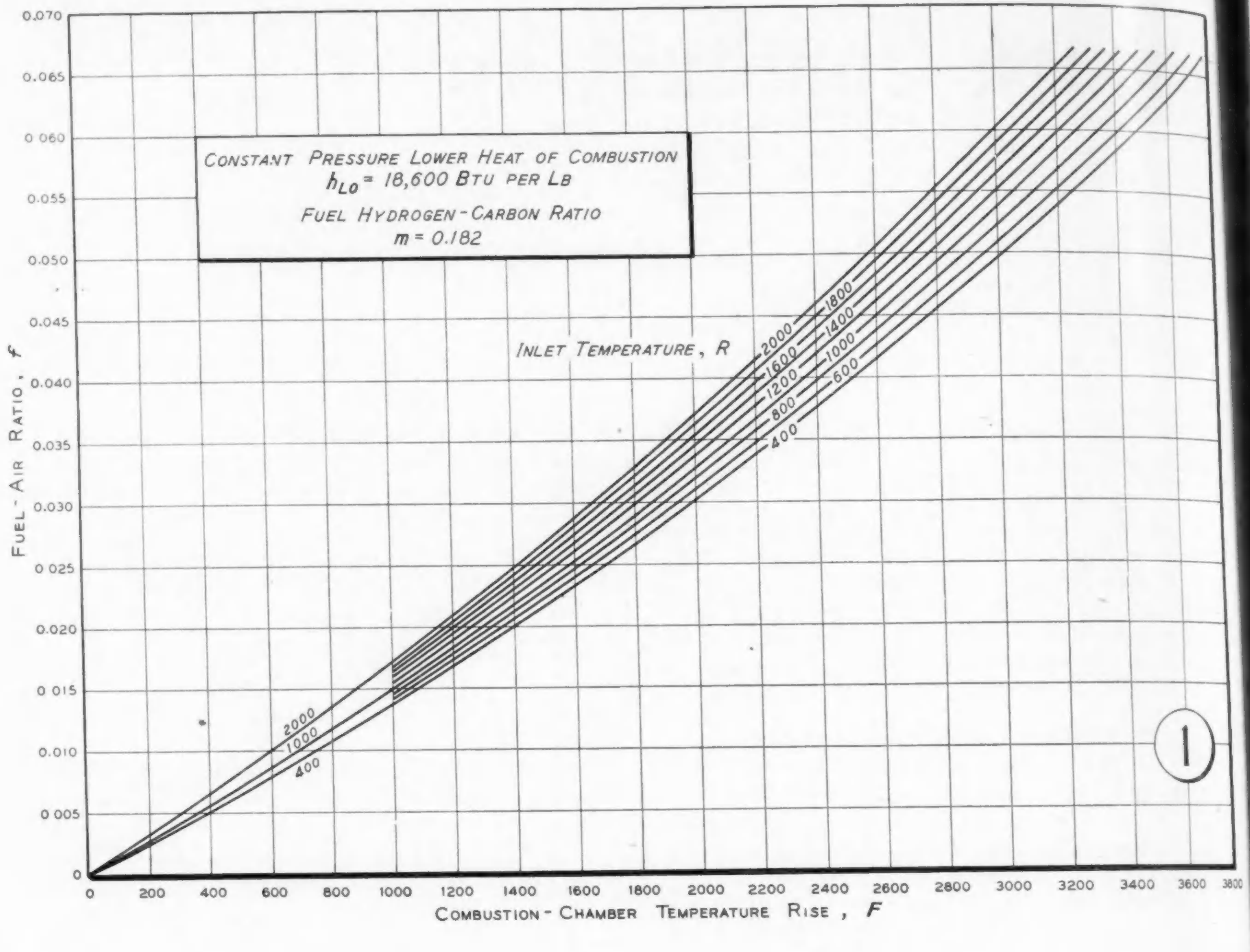
If the enthalpy of the products of combustion given by equation (2) is substituted, the basic energy equation (1) becomes:

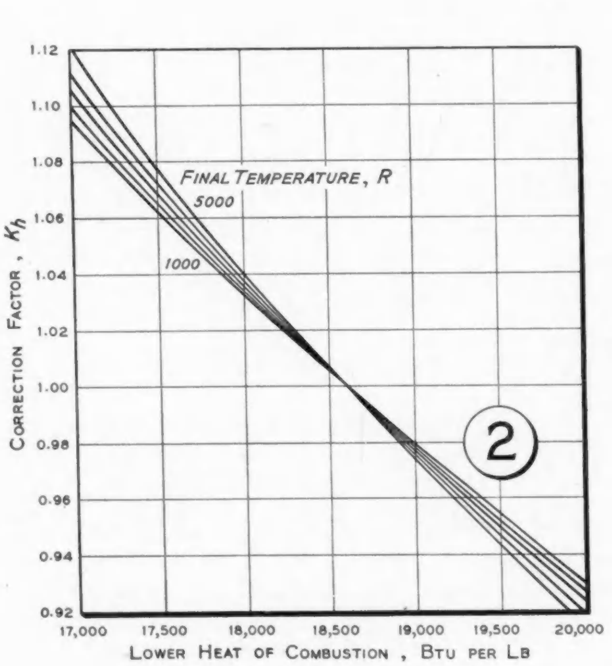
$$w_a(h_{a1} - h_{a0}) + w_f(h_{f2} - h_{f0}) + w_f h_{L0} = w_a(h_{a2} - h_{a0}) + w_f(h_{p2} - h_{p0}) \tag{4}$$

from which the fuel-air ratio becomes:

$$f = \frac{w_f}{w_a} = \frac{h_{a2} - h_{a1}}{h_{L0} + (h_{f2} - h_{f0}) - (h_{p2} - h_{p0})} \tag{5}$$

This formula has been used to construct Fig. 1, for which it has been assumed for convenient reference that $h_{L0} = 18{,}600$ Btu per lb, $T_3 = T_0$, and $m = 0.182$. Correction factors to take care of other heats of combustion and fuel hydrogen-carbon ratios are given in Figs. 2 and 3. These factors are derived from equation (5), and are to be applied independently. The effect of variation of hydrogen-carbon ratio on heat of combustion has not been included by Hall, since the heat of combustion also depends to such a large extent on molecular


Constant Pressure Lower Heat of Combustion
h_{Lo} = 18,600 Btu per Lb
Fuel Hydrogen-Carbon Ratio
m = 0.182
Inlet Temperature, R
2000
1800
1600
1400
1200
1000
800
600
400
Fuel-Air Ratio, f
Combustion-Chamber Temperature Rise, F
1


Final Temperature, R
5000
1000
Correction Factor, K_h
Lower Heat of Combustion, Btu per Lb
2

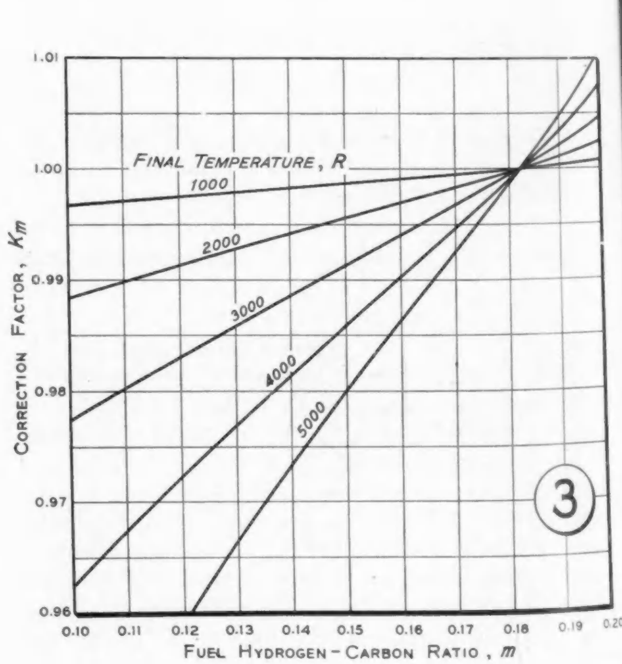

Final Temperature, R
1000
2000
3000
4000
5000
Correction Factor, K_m
Fuel Hydrogen-Carbon Ratio, m
3

Fig. 1 (upper left) – Uncorrected fuel-air ratio for constant-pressure combustion of hydrocarbon fuels

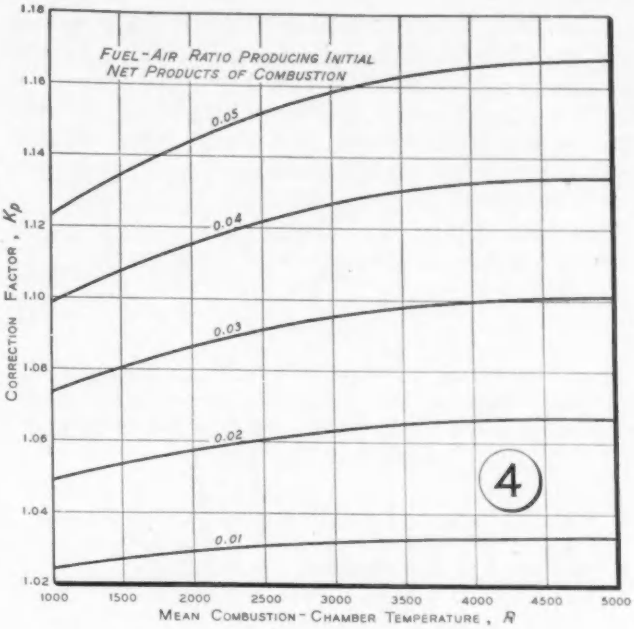
Fig. 2 (lower left) – Fuel-air ratio correction factor for heat of combustion

Fig. 3 (lower middle) – Fuel-air ratio correction factor for fuel hydrogen-carbon ratio

The ease with which these charts can be used is illustrated by the following example:

It is desired to find the fuel-air ratio required to raise the temperature from 1100 R to 2400 R. The fuel has a hydrogen-carbon ratio of 0.170 and a lower heat of combustion of 18,200 Btu per lb. The air entering the combustion chamber contains the products of previous combustion at a fuel-air ratio of 0.02 and water vapor at a water-air ratio of 0.04.

Fig. 1 gives an uncorrected fuel-air ratio of 0.0203. The correction factor for heat of combustion is given in Fig. 2 as 1.023. The correction factor for hydrogen-carbon ratio is given in Fig. 3 as 0.998. The correction factor for previous products of combustion is given in Fig. 4 as 1.058. Fig. 5 gives a correction factor of 1.080 for water vapor. The corrected fuel-air ratio is the product of the uncorrected value and these factors, or $0.0203 \times 1.023 \times 0.998 \times 1.058 \times 1.080 = 0.0236$.



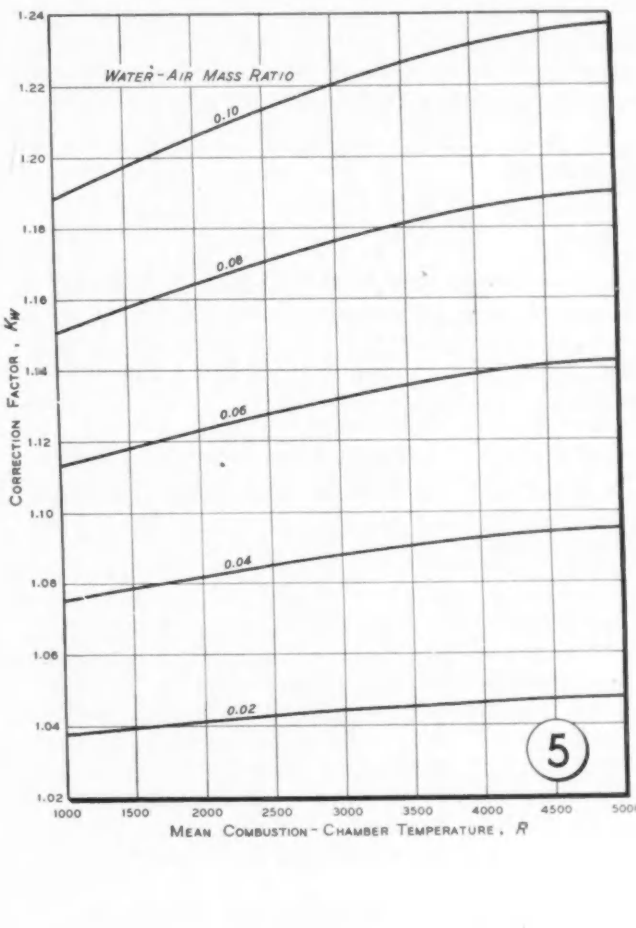


Fig. 4 (upper right) – Fuel-air ratio correction factor for net products of combustion in inlet air

Fig. 5 (lower right) – Fuel-air ratio correction factor for water vapor in inlet air

structure. Formula (5) indicates that the effect of fuel injection at a state differing from liquid at 60 F may be accounted for by adding to the heat of combustion the difference between the enthalpy at the new state and that at the reference state.

When the working medium entering the combustion chamber contains substances other than air the change in specific heat makes it necessary to apply a correction to the fuel-air ratio. This correction will be developed for the presence of the products of previous lean-mixture combustion and for the presence of water vapor.

The enthalpy of products of lean-mixture combustion has been shown above to be given by:

$$h_g = \frac{h_a + f h_p}{1 + f} \tag{6}$$

If the working medium entering the combustion chamber contains the products of previous combustion at a fuel-air ratio f_1, the energy balance corresponding to equation (4) will be:

$$w_a(1 + f_1)\frac{h_{a1} + f_1 h_{p1} - h_{aO} - f_1 h_{pO}}{1 + f_1} + w_f(h_{f3} - h_{fO})] + w_f h_{LO} =$$
$$w_a(1 + f_1)\frac{h_{a2} + f_1 h_{p2} - h_{aO} - f_1 h_{pO}}{1 + f_1} + w_f(h_{p2} - h_{pO})]] \tag{7}$$

The fuel-air ratio is then given by:

$$\frac{w_f}{w_a} = \frac{h_{a2} - h_{a1} + f_1(h_{p2} - h_{p1})}{h_{LO} + (h_{f3} - h_{fO}) - (h_{p2} - h_{pO})} \tag{8}$$

so that the fuel-air ratio with products of combustion added to the entering air f_p may be obtained from that for pure air f_a by the formula:

$$f_p = f_a K_p \tag{9}$$

where:

$$K_p = 1 + f_1 \frac{h_{p2} - h_{p1}}{h_{a2} - h_{a1}} \tag{10}$$

The correction factor K_p is given in Fig. 4 for the fuel hydrogen-carbon ratio $m = 0.182$ as a function of the mean combustion-chamber temperature $(T_1 + T_2)/2$ and the fuel-air ratio for the previous combustion.

Water Vapor

If water vapor is present in the entering air the fuel-air ratio f_w can be obtained from that for pure entering air by:

$$f_w = f_a K_w \tag{11}$$

where the correction factor K_w is given by Fig. 5 as a function of the water-air mass ratio and the mean combustion-chamber temperature. K_w is determined analytically in the same manner as K_p, replacing the enthalpy of the net products of combustion by the enthalpy of water vapor. Similar corrections can be developed for the presence of any other substance in the entering air that does not undergo a chemical change in the combustion chamber.

When heat loss or incomplete combustion occurs the decrease in heating effectiveness is measured by an experimentally determined combustion efficiency. Two definitions of this efficiency are in current use.

The first, emphasizing the function of providing a temperature rise, states that combustion efficiency is the ratio of the ideal fuel consumption to the actual fuel consumption for specified inlet and discharge temperatures.

This definition can be accurately and rapidly correlated with test observations. Test analyses will give the heat of combustion and the hydrogen-carbon ratio of the fuel. The ideal fuel-air ratio can be obtained directly from observed inlet and discharge temperatures by the use of Figs. 1, 2, and 3. The combustion efficiency follows as the ratio of this ideal to the measured fuel-air ratio.

The second definition, referring to the chemical energy in the fuel, states that combustion efficiency is the ratio of the actual increase in enthalpy of the working medium to the constant-pressure lower heat of combustion of the fuel.

This definition will require a careful gas analysis in order to determine the enthalpy level at the discharge. The question will also always occur, whether the process should be charged with all the energy represented by the heat of combustion referred to an arbitrary base temperature.

In view of this comparison, Hall recommends that the first definition be used, as given by the formula:

$$\eta_{comb} = \frac{f_{ideal}}{f_{actual}}$$

The definitions would be identical if it were not for thermodynamic effects of the injected fuel and the net products of combustion. In any case, however, they will not differ greatly except for very low efficiencies.

APPENDIX

Notation

f = Fuel-air ratio

h_a = Enthalpy of air

h_f = Enthalpy of fuel

h_g = Enthalpy of products of combustion

h_p = Enthalpy of net products of combustion

h_{C_p} = Enthalpy of carbon net products of combustion

h_{H_p} = Enthalpy of hydrogen net products of combustion

h_{H_2O} = Enthalpy of water vapor

h_{CO_2} = Enthalpy of carbon dioxide

h_{O_2} = Enthalpy of oxygen

h_{LO} = Constant-pressure lower heat of combustion, Btu per lb

T_O = Reference temperature for heat of combustion, F

T_1 = Mean stagnation temperature at combustion-chamber inlet, F

T_2 = Mean stagnation temperature at combustion chamber discharge, F

T_3 = Temperature of injected fuel, F

w_a = Airflow rate, lb per sec

w_f = Fuel flow rate, lb per sec

Income Account (in thousands of dollars) of 14 Airlines for January and February 1946, as Compared with the Same Months in 1945

Year	Revenue	Expense	Net Operating Income	Profit or Loss
1946	$30,125	$34,788	–$4,663	–$3,490
1945	23,735	20,522	+ 3,213	+ 1,836
Difference	......	......	–$7,876	–$5,326

Booming Airline Business Leaves Gloomy Profit Outlook

FROM PAPERS BY **Prof. L. L. Bollinger and H. E. Nourse** *

DESPITE the lucrative onrush of business faced by commercial airlines, they will be operating—paradoxically—at a loss, and costs will skyrocket out of all proportion to income, prophesy both Mr. Nourse and Professor Bollinger.

Factors favorably influencing profits during the war period more than offset negative factors. But the plus elements will inevitably give way to the minus ones in the next few years. Additionally, mushrooming business will necessitate rapid expansion of facilities, the brunt of which will have to be borne by the airlines themselves instead of by municipalities, as has been the case to date.

That commercial aviation will operate at a loss for at least the immediate future is no wild claim, soberly observes Mr. Nourse. He says his belief is only too well substantiated by profit-and-loss statements. Full impact of this trend is readily seen in the table, which gives the income account of 14 airlines for the months of January and February, 1946, as compared with the same months in 1945.

Why the sudden reversal so adversely affecting the changeover from war to postwar operation? It is Mr. Nourse's contention that:

Firstly, a return to normal travel conditions brings with it a reduction in revenue per volume carried. Although the demand for air travel will increase, airlines will at the same time increase carrying capacity to better satisfy public convenience. Limited facilities during the war years boosted the annual load factor, forcing a greater ratio of passenger miles flown to airplane miles flown per volume carried. Also a return toward prewar seasonal curve of monthly passenger miles, airplane miles, and passenger load factors increases direct flying cost per unit volume.

During the war airlines were unable to replace airplanes that became fully depreciated. Replacement long overdue will now add to the unit cost. Adding to the list of profit parasites is the increased cost of doing business—labor, services, and material—that is due to rise for some time to come.

Domestic airlines reduced fares in 1945 in the face of a general rise in price levels. The real cost

* Paper "Airport Costs and Air Carrier Responsibilities", by Prof L. L. Bollinger, Harvard University, was presented at the SAE Metropolitan Section Meeting on May 23. Paper "Economic Factors in Air Transportation Which Will Control Profits in 1946 and 1947", by H. E. Nourse, United Airlines, Inc., was presented at the SAE Summer Meeting, June 6, 1946.

of passenger air transportation today, in terms of the 1940 price level, is between 3 and 3½¢ per mile. Although this reduction in air fares will create additional volume, air transport economists doubt that increased volume at lower fares will boost profits during 1946 and 1947.

Burden costs pro-rated against military contracts must now be carried by civilian business.

Bright Side of Picture

But several rays of light do penetrate this foreboding picture. More economical and more efficient airplanes lowering cost per seat-mile and ton-mile capacity will become available shortly. Greater number of seats per airplane will reduce direct flying costs per volume carried.

Design characteristics of new airplanes will allow full advantage of payload capacity regardless of length of flight between refueling. The postwar airplane will be faster than its wartime predecessor, and even a greater daily mileage utilization than the wartime figure of 2000 is expected. This will help partially to offset the higher depreciation charges.

Another bright spot is the anticipated reduction in taxes. Basic income tax rates should be reduced and the excess profits tax will have been removed. Expected reduction of airmail postage to 5¢ will increase volume and revenue. This will accrue almost directly to profits as there will be cargo space available in airplanes already flying.

On the whole, the minus factors in air transportation during 1946 and 1947 will predominate and will reduce profits greatly. More efficient flying equipment will not completely erase the negative factors, some of which are temporary, until some time in 1947.

Professor Bollinger is not so optimistic. He feels that airport costs constitute the most serious problem facing the airlines today. How these costs are written off is the key to financial success of commercial aviation. In posing the problem and a possible solution, he points out that:

New Fields Overwhelming Burden

To provide the amount of air transportation services contemplated, the industry must face prospects of an investment in terminal type airports exceeding two billion dollars. Annual cost of carrying this airport investment will be approximately $200,000,000 *after* the original financing and construction is completed.

Gigantic proportions of the prospective $200,000,000 annual airport investment become all the more apparent when contrasted with the total net income of $34,000,000 earned by the domestic airlines during the profitable year of 1945. Total assets of these airlines were only $213,000,000 as of mid-1945.

Of the $200,000,000, some $80,000,000 will be incurred annually for airport buildings and $45,000,000 for landing areas, or a total of about $125,000,000 a year after aviation has reached a point of reasonable maturity.

The $64 question is: How much of the $125,000,000 will air carriers themselves have to pay in the form of landing fees, building rents, and other direct charges?

Cities have for many years provided airports at considerable expense to the public treasury. We have only to read the daily newspapers to see that city officials are completely fed up with airport deficits. The former attitude of helping the poor struggling pioneers of the air is rapidly disappearing. Today city fathers mean business when they say they are going to put airports on a pay-as-you-go basis. They have their eyes primarily on the airlines' pocketbook.

Unless prospective level of airport costs can be cut sharply or other sources of airport revenue developed, air carriers will have to shoulder a back-breaking portion of the $125,000,000.

But can terminal-type airports be made self-supporting without an undue burden on commercial aviation? If so, how? An intensive investigation of 51 airports conducted by the Harvard Business School (under the leadership of Professor Bollinger) indicates that a majority of terminal-type airports can be made self-supporting within a reasonable time – provided a sound financial plan is established and all revenue sources aggressively developed.

First and most conspicuous way in which air carriers might help reduce the burden of airport costs is through assisting in planning airport construction. Badly balanced airport expansion plans at many cities reflect, in part, lack of balance in information and advice supplied by the airlines. Too often advice appears to have been motivated by a strictly operations viewpoint.

Unsound Advice May Boomerang

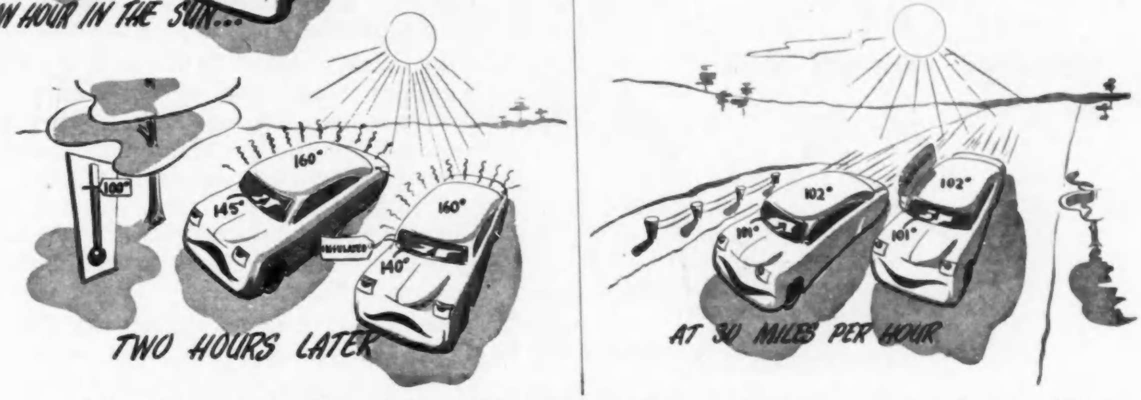
Many airline representatives believe the bigger and better the facilities acquired at public expense, the better their company interests are served. More prudently planned airports might result if airline management realized that every time its representatives encourage excessive or poorly balanced airports, the airlines themselves are incurring a responsibility for heavier future costs.

Difficulty in present-day airport financial management can be traced to inadequacies in revenue-producing activities rather than to high operating costs. Tendency of the industry to blame present financial difficulties on deliberate maladministration is unfounded. If anything, municipal airport operating expenses are too low – representing under-maintenance.

It is in and about the terminal building that air transportation seems to suffer most from municipal control over current operations; it is in the

concluded on page 46

Heat and Sound INSULATION



Insulation of automobiles is futile in itself, as these cartoons show. Fig. 1, upper left, shows a 15 F advantage, which drops to 5 F differential two hours later (Fig. 2), and this disappears when the cars are in motion, Fig. 3, right

DIGEST OF A PAPER BY

LAURENCE M. BALL*

CONTRARY to popular belief, insulating the roof of an automobile or truck cab alone will add little comfort to passengers and driver. The four most important factors in thermal insulation of a vehicle are:

- Dash and floor treatment.
- Sealing against infiltration of underhood air.
- Abundant supply of ventilating air.
- Shielding against radiation of heat from the exhaust system.

Psychological effects which sounds produce when they enter the human ear are of great importance to the automotive engineer. These are the basic steps to reduce noises:

- Reduction of sound at the source.
- Mechanical insulation.
- Damping of resonant elements.
- Insulation.
- Absorption.

As shown in Figs. 1, 2 and 3, roof insulation merely delays heating up the interior of a car by the sun's rays.

However, when a car is air conditioned, insulation of the roof becomes extremely important. Thermal insulation lightens the load on the refrigerating equipment in warm weather and when a heater is used in winter this precaution also will lighten the heat load.

For example, air under the hood is often as much as 40 F hotter than atmosphere. Any cracks, holes, or openings in the dash or floor can admit this heated air and raise the temperature around the passengers' feet and legs to an uncomfortable level.

The cure is to seal the dash and floor effectively, and provide plenty of ventilating air at floor level. This means considerably more than is provided in current models. Carpeting as ordinarily used is quite effective as a thermal insulator.

Exhaust systems, handling gases at 1000 F, send powerful heat radiations to the floor. At 60 mph, radiation from the muffler raises the temperature of the floor well above frying point, or 336 F. The carpeting brings the floor temperature down nearly 200 F, or to 144 F below the heat of the metal floor, Fig. 4A.

This can be further reduced by a simple shield between the muffler and floor, as seen in Fig. 4B. Material for this muffler shield need not be selected on the basis of its emissivity for radiant heat, the essential point being that the shield is much cooler than the muffler and radiates much less heat.

Sound, as does heat, presents a problem of "dual personality." The strength or intensity of sound

*Paper "Heat and Sound Insulation," by Laurence M. Ball, head Electronics Laboratory, Chrysler Corp., was presented before SAE Detroit Section, Sept. 30, 1946.

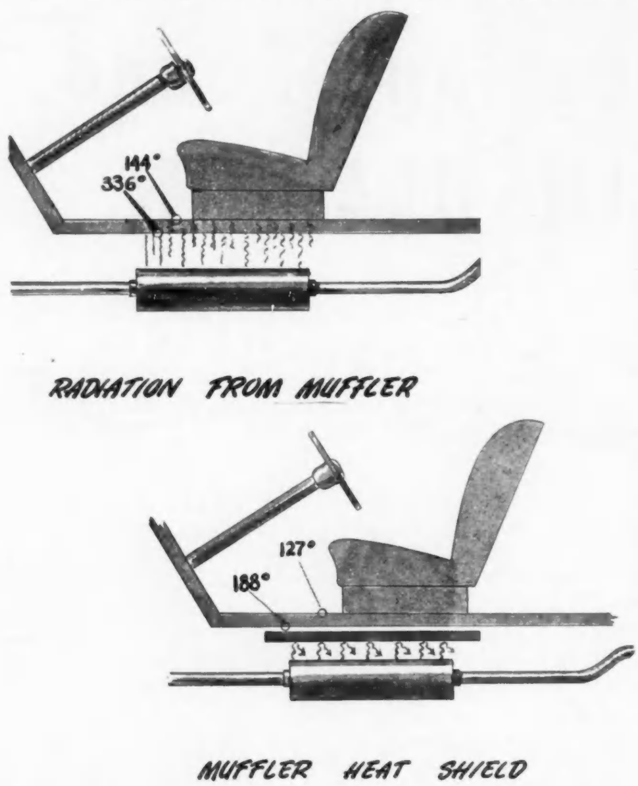


Fig. 4 A and B – Simple baffle plate over muffler (above) goes far to cool automobile's floor as shown in temperature drop of 17 F (below)

is related to its psychological reaction on human beings, or loudness.

Extraordinary advances in the field of applied acoustics have been made during the past 15 years, but to date the physical aspects of sound do not throw any light on the psychological effects of sound. Only the latter is of importance to automobile engineers, because in this lies public acceptance.

Frequently the sound can be reduced at its source, which, of course, is the most obvious remedy. Better balancing of rotating parts, reduction of clearances in reciprocating parts, and general improvement in design and construction should be relied upon first.

Resilient mountings offer further possibilities when it is impractical to refine component designs further. A great deal of technical literature has been published on this point.

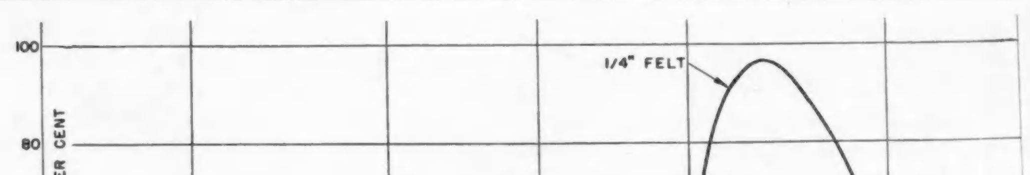
In some cases, vibration at resonance can be partially neutralized by the addition of a small spring mounted mass tuned approximately to the resonant frequency. The dynamic absorber always introduces two new neutral frequencies, which by proper adjustment of tuning and damping can be made less severe than the original resonance. Resonant torsional vibrations in crankshafts have been reduced in this manner.

Resonant elements, such as flat thin metal panels, can be dampened by applying sound absorbing material, such as felt treated with asphalt and sand or limestone fillers. Doors treated thus lose their tinny sound when slammed.

Insulation of disturbing noises can be achieved by enclosing the offending part in a box. The enclosure should be as heavy and as complete as possible. It is not necessary to make the enclosure of sound absorbing material, acoustical authorities have shown.

Sound absorbing materials should be used only after all other methods have been employed. In this extremity, the sound frequencies should be analyzed and the material chosen should have high absorption at these frequencies.

Fig. 5 – Sound absorption coefficients must be studied by design engineers, because values of various materials differ



By baring a method of selecting bearing lining material, Messrs. Watson and Thill strip this trying task of many problems that enshroud it.

In this article they compare the performance of present day bearing alloys and offer both engine-eer and engine operator a practical tool to rational choice of the right bearing for the job.

Bearing Selection Guided by Relative Material Merits

From a paper by **R. A. Watson and W. E. Thill***

WHY an alloy of certain constituents behaves satisfactorily when used as a bearing for a turning lubricated shaft under load and another containing other elements fails completely under exactly the same conditions is still a universal mystery. First requisite of an alloy that makes it function as a lining material is that indefinable ingredient – bearing quality. Through experimentation and research certain alloy families having this peculiarity have been found; it is hoped that in time many more will be discovered.

In addition to "bearing quality," these nine qualifications are definitely desirable in a bearing:

1. Fatigue Resistance – ability of bearing lining material to withstand shocks and loadings without deterioration;
2. Conformability – tendency of the material to flow or creep slightly – especially in the initial stages of running – to allow shaft and bearing contours to conform to each other;
3. Embeddability – quality of the lining that allows absorption of slight dirt particles into it, saving the shaft or other moving parts against abrasion;
4. Anti-Scoring Tendencies – permitting shaft and bearing to get along with each other;
5. Corrosion Resistance – resistance of lining to attack by organic acids sometimes formed in oil under abnormal operating conditions;
6. Capability of operating with unhardened shafts;
7. Bondability – being capable of bonding well with backing;
8. Temperature-Strength Ratio – ratio of loss in lining's compressive strength due to temperature increases;
9. Thermal Conductivity – ability to absorb and carry away friction heat generated in the oil at the bearing.

It is obvious that an ideal bearing material containing all of the above qualities in the quantities desired does not exist; it is not likely that a material will ever be discovered that is capable of high fatigue resistance and at the same time soft enough to creep and to absorb small particles.

Apparently selection of any bearing lining material is a compromise – certain physical properties are lessened to gain others important to a particular functioning of the material as a bearing alloy.

To illustrate how present bearing materials compare with each other as regards these properties, these eight alloy families have been chosen:

1. Tin base babbitts,
2. High lead babbitts,
3. Cadmium alloys,
4. Copper alloys,
5. Copper alloys – overplated,
6. Aluminum alloys,
7. Silver,
8. Silver – overplated.

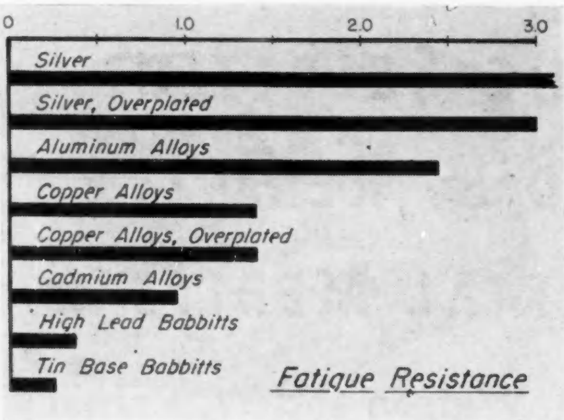
It is necessary here to deal in generalities in the pattern since deviations in constituents in any one alloy alter that alloy above or below the charts portrayed. These charts do demonstrate the relative properties of an average cross section of each of the eight lining material groupings.

In Fig. 1 is shown a chart of bearing fatigue resistance characteristics.

Since a silver lining with a lead overplate represents the optimum in fatigue resistance of all materials shown, it is designated as the ideal. The other materials are plotted relative to it. Pure

* Paper "Practical Aspects of Sleeve Bearing Materials," by R. A. Watson and W. E. Thill, Federal-Mogul Corp., was presented at SAE National West Coast Transportation & Maintenance Meeting, August 23, 1946.

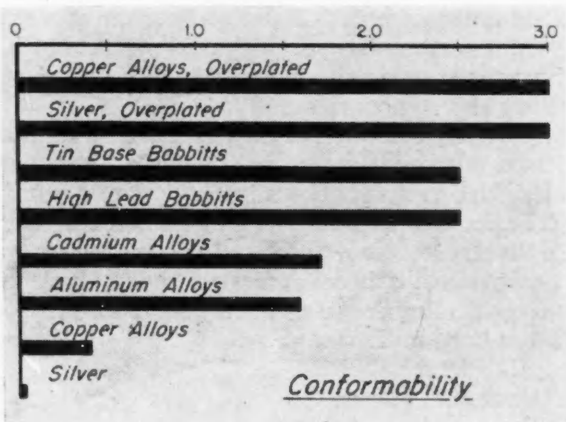
■ Fig. 1



silver is given first position. As will be shown later, pure silver without an overlay is generally impractical; but it is shown to enhance the relative picture and to show why it is impractical in most operations. Note that tin and lead base alloys are lowest in fatigue resistance.

Following in Fig. 2 is the conformability or "plastic flow" characteristics of the general alloys.

■ Fig. 2



This chart is indicative of the value of overplating. Silver is very low because its contact with a rubbing shaft under load hardens the material.

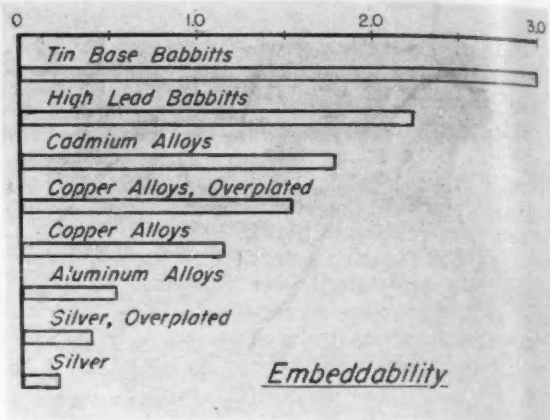
Shown in the next chart, Fig. 3, are the embeddability properties of each alloy group.

Tin base babbitts lead the field with high lead babbitts second. Silver again is in the least desirable position.

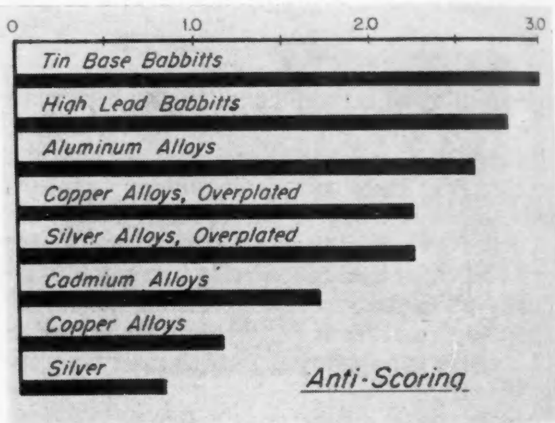
In preparing the relationships of anti-scoring tendencies, Fig. 4, the shaft in all cases is of the same, texture, finish, and hardness.

Tin base babbitt is the best – it has the least effect upon the shaft in this respect. Again silver is trailing.

■ Fig. 3

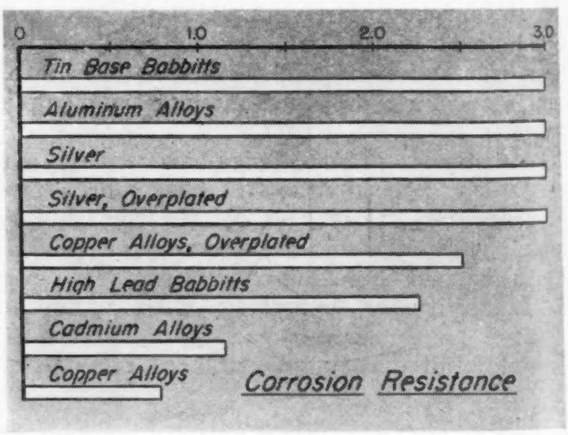


■ Fig. 4



How the groups compare as to corrosion resistance is shown in Fig. 5.

■ Fig. 5

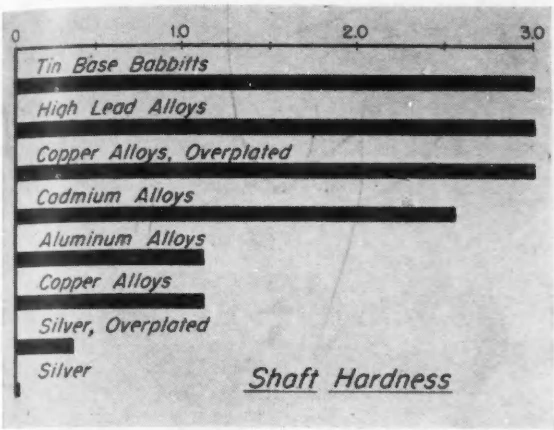


Today this information is less significant than it would have been several years ago since corrosion

has become extremely rare. This chart was compiled by actual laboratory experiment in which organic acid was deliberately added to the oil.

Depicted in the chart in Fig. 6 is the ability of the materials to operate with soft shafts.

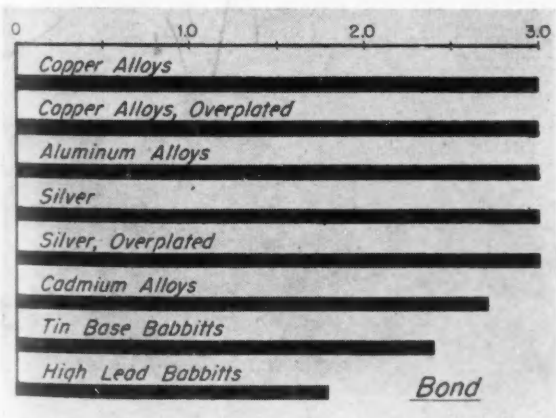
■ Fig. 6



The alloys in the lower portion require shafts that have been heat-treated or otherwise hardened above normal. Lead, tin, and overplated copper alloys can operate with an ordinary soft shaft; cadmium alloys require a 250 Brinell shaft or better; aluminum and copper-lead, a 300 Brinell shaft; and over-plated silver a Brinell of 600 or over. Tests of pure silver on even very hard shafts have resulted in seizure of bearing to shaft.

Bondability of a lining to its backing is illustrated in Fig. 7.

■ Fig. 7



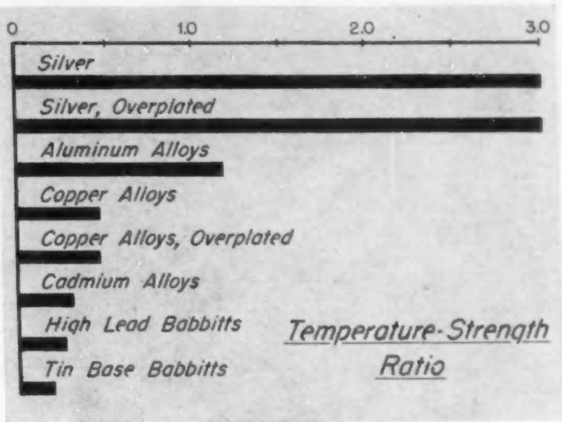
This property is actually of greater concern to the bearing manufacturer than it is to the user. It is important to the user in that the tenaciousness of the lining to the backing under conditions of flexure may render his bearing either good or bad.

Quality of temperature ratio or the ratio of loss of compressive strength due to increases in temperature is represented in Fig. 8.

By virtue of its high heat resistance, silver is in the leading positions and aluminum alloys second. All others are relatively low.

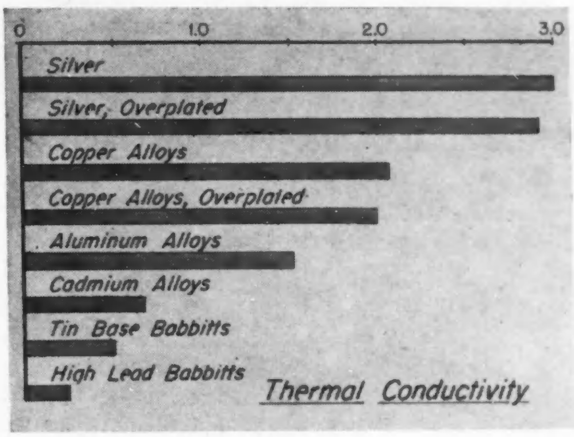
Last property, heat conductivity, is especially important when a mechanical unit is operating

■ Fig. 8



under adverse heat conditions. The relationships shown in Fig. 9 emerge.

■ Fig. 9



Heat is always generated at a bearing even though well lubricated. It evolves either from friction of shaft against bearings or by shearing of the oil molecules. Ability to carry away such heat is important. Silver leads the field in this respect, lead and tin are at the tail end.

These charts are of interest because they portray the wide range of values each family of alloys has when plotted against desirable properties that make up a good bearing. It can be seen that the features depicted are not equal to each other in absolute value when comparing one against the other to produce the overall good bearing.

In combining the charts to examine each bearing

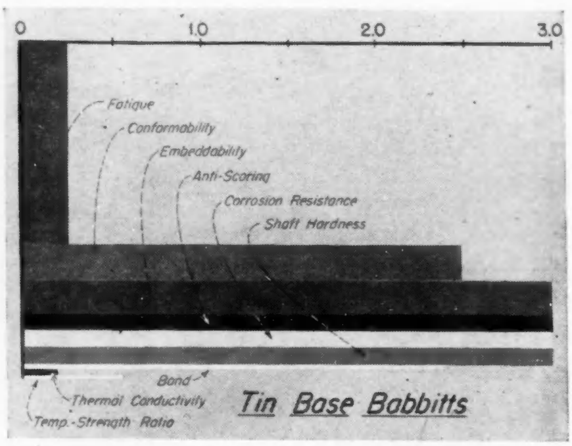
family in all its phases, a pattern was set up with the all-important connecting rod and main bearing usages in mind. This relation – totaling 100% and giving different values for the nine characteristics – was arbitrarily set up as follows:

Fatigue Resistance	60%
Conformability	10%
Embeddability	10%
Anti-Scoring	5%
Corrosion Resistance	5%
Shaft Hardness	5%
Bond	2%
Temperature-Strength Ratio	2%
Thermal Conductivity	1%
Total	100%

The bars shown in each of the following charts represent the above properties in that order, from top to bottom.

Pictured first is the composite for general tin base alloys, Fig. 10.

■ Fig. 10



Aside from the rather low fatigue strength, most of the other items are well up the scale. Strength-temperature ratio is low, but best performance of any bearing material cannot be expected if high abnormal operating temperatures prevail.

Because of lowered tin imports, trend has been toward substitutions with high lead babbitts. Averages of these alloys are plotted against the salient requirements in Fig. 11.

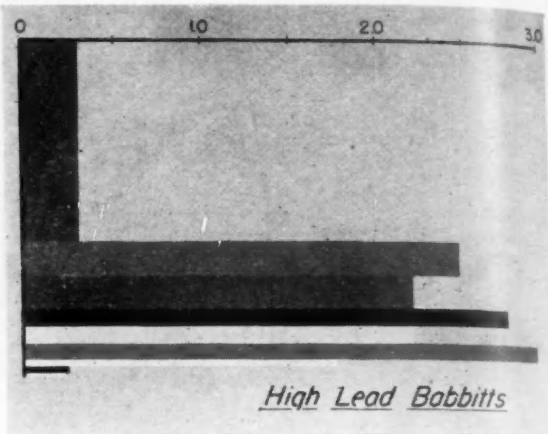
Substituting lead for tin babbitts has not been universally popular as comparison of the tin and lead charts reveals a slight sacrifice in all major items except shaft hardness. Some users of bearings with lead babbitts are well satisfied with the material and intend to continue using it after tin is again available.

Charted in Fig. 12 are cadmium alloy properties.

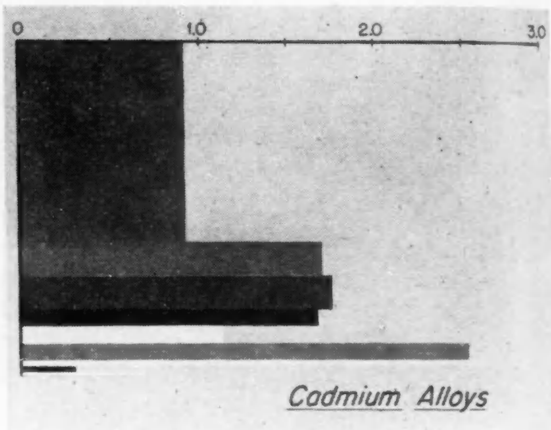
Good fatigue strength is offset by some loss of conformability and embeddability. Score resistance is low and the material is subject to attack by acids formed in the oil.

Next alloy group, shown in Fig. 13, is the copper-leads.

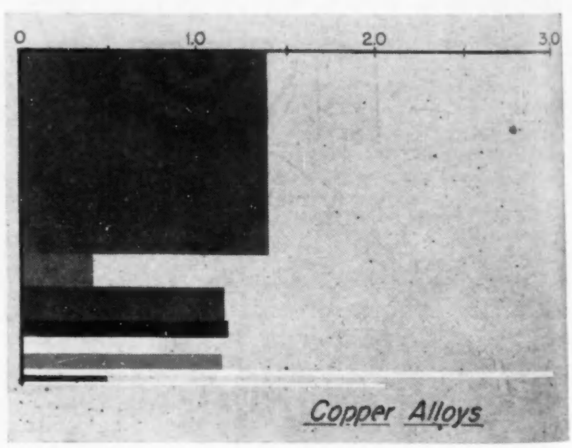
■ Fig. 11



■ Fig. 12



■ Fig. 13

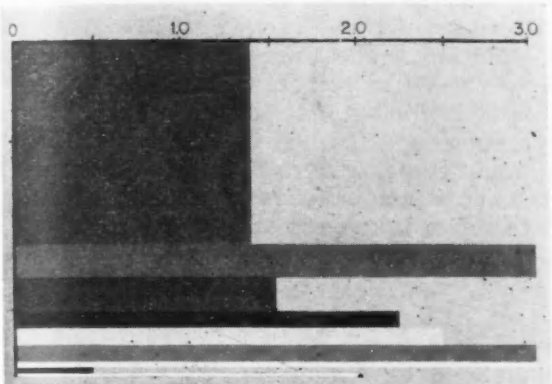


Fatigue resistance is better than the previous alloys but at a sacrifice in other desirable qualities. By inclusion of larger amounts of lead in copper-lead alloys, many of the properties can be improved at a corresponding loss in fatigue resistance – and vice versa.

An example of improvement by overplating is the Fig. 14 property-picture of an average copper alloy material overplated with the usual thin coating of a high lead alloy:

It is readily apparent that conformability, anti-scoring, corrosion resistance, and requirements for shaft hardness are much improved, bettering such bearing where these factors are important.

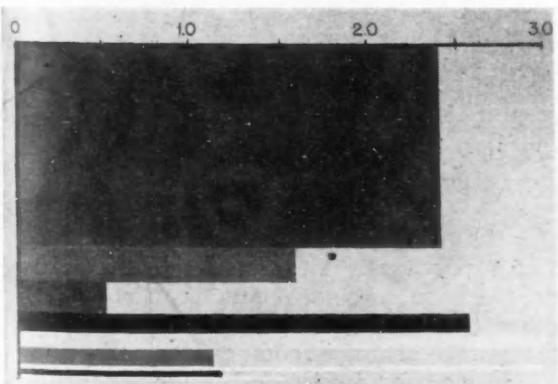
■ Fig. 14



Copper Alloys, Overplated

Why the new aluminum alloys are an important addition to the bearing field is demonstrated in Fig. 15.

■ Fig. 15

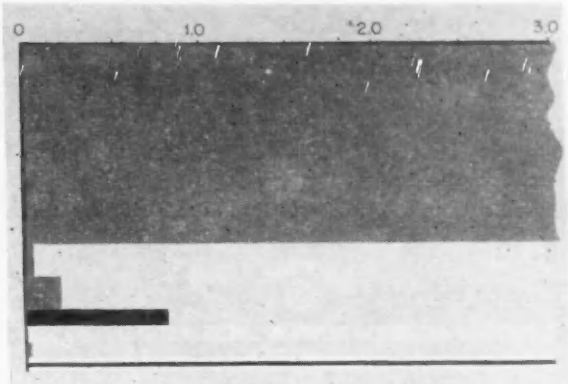


Aluminum Alloys

They have many very desirable characteristics among which is fatigue resistance. Aluminum shows remarkable promise in applications where shafts are reasonably hard and dirt infiltration is controlled as much as is practical. While embeddability is low, the extent of its other characteristics render it a valuable material.

An illustration of a material usually unsuitable in itself as a bearing material is charted by the properties of pure silver in Fig. 16.

■ Fig. 16

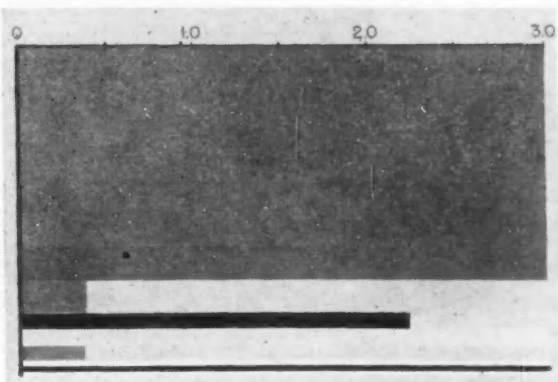


Silver

Fatigue resistance is very high, almost indeterminate because the material work hardens. Shaft and bearing seem to get along well together if the shaft is very hard. But for some unknown reason this "happiness" does not last; sudden seizure to the point of permanent welding of shaft-to-bearing results.

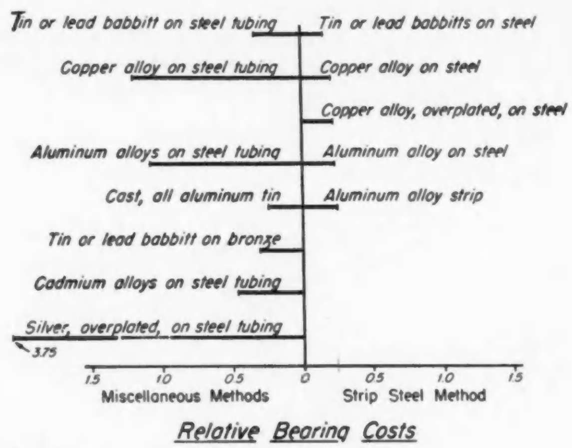
Real instrument that has made silver useful as a bearing material, especially in aircraft applications, has been overplating, characteristics of which are depicted in the last chart, Fig. 17.

■ Fig. 17



Silver, overplated

Its fatigue strength is the greatest of all bearing materials. Conformability is made possible by the addition of relatively soft material. This development has been largely responsible for many more hours of flying time between engine overhauls, to-



■ **Fig. 18**

gether with fewer mishaps due to bearing failures.

Next to physical properties required of a bearing for a particular application is the cost factor. The material groupings under discussion also can be compared as to relative cost.

For illustrative purposes we selected a plain bearing of such proportions that it could be made by any method we chose (a practical impossibility) with simple grooving and of medium size. A large quantity, approximately 10,000, was selected as the production requirement. This hypothetical set of conditions gives the cost relationship shown in Fig. 18.

It appears that a tin or high lead babbitt with its relatively low cost in large quantities might prove more sound a selection than a more costly material requiring a hardened shaft. The babbitts must, of course, be capable of carrying the intended loadings.

While bearings will continue to rate high on the list of both the engine designers and operator's problems, it is possible to select them judiciously by comparing bearing materials for an intended use as regards relative performance characteristics and cost.

AIRLINE PROFITS

continued from page 38

terminal building area that better control and management are needed. This might well be provided by those who pay the bill and bear the consequences—the air carriers.

Need for more air-carrier participation in terminal building operation becomes more clear-cut when importance of concession revenues is examined. At an active, well-managed terminal-type airport, the nonaviation concession revenues from restaurants, shops, spectator ramps, and the like are so important that they will generally determine whether or not an airport can be self-supporting.

At Washington National Airport, for example, revenues from non-aviation concessions and spectator ramps were $157,000 in 1945, or 26% of airport revenues, compared with $45,000, or 7½% from landing fees.

Restrictions on public officials as custodians of public property prohibit business risk-taking and promotional efforts for concession development. Incentives and freedom of action can come only from a joint air terminal corporation, financed by air carriers and patterned along the lines of successful railroad terminal corporations. Landing areas could be left under public administration.

Such a corporation might also permit substantial economies by taking over some noncompetitive ground operations now unnecessarily duplicated by each air carrier. Total economies from this source may go a long way toward increasing airport charges without raising air transport costs.

In addition to the already proven revenue sources, the far-seeing private corporation can develop profitable shopping and recreational centers at advantageously located airports. It may be possible to develop these activities to the point where the entire airport can be made self-supporting without cost to either taxpayers or air commerce.

ALLOY STEELS

continued from page 25

nickel are used in steels of moderate hardenability. The question is whether this practice is advantageous or otherwise in comparison with the use of a smaller number of alloy elements.

The advantage of the triple alloy steels was obvious when alloy conservation was a war necessity, in view of the impracticability of adequate scrap segregation. Conservation remains important in peacetime because of both the cost of alloy additions and the fact that supplies of alloying elements are not inexhaustible. The triple alloy steels are probably of more immediate interest to the consumer because of the fact that all of the alloying elements are under positive control, which should be conducive to more uniform behavior.

The importance of hardenability in the selection of steel is unquestioned, but it should not be assumed that hardenability is the only consideration of importance. The suggestion has even been made, perhaps not seriously, that steel may be specified in terms of hardenability alone without any regard to chemical composition. It seems evident that carbon content and the general composition of the steel with respect to alloying elements also need to be specified if for no other reason than to permit the maintenance of fixed fabricating and heat treating operations. Furthermore, steels having almost identical Jominy curves in the hardened condition do not necessarily have the same mechanical properties when tempered to a given hardness.

Aircraft Engine Starters

Based on a Paper by **ARTHUR BEIER***

WEIGHT of electric starter installations on military craft reduced by one-half; reliability of starting equipment increased; simplified operation, installation, and maintenance – these are practical results of a research program designed to alleviate the engine starting headache that was plaguing manufacturers and users of aircraft.

Detailing the research program and the conclusions to be drawn from it, Mr. Beier brings out the following points:

The first step taken was to determine which type of starter had the greatest potentialities. All doubts were quickly resolved in favor of the direct cranking starter – which provides continuous and relatively constant cranking speed by means of an electric motor connected to the engine through a gear train – for several reasons:

(a) It provides an extended period for adjustment of engine controls to effect starting.

(b) It requires the least amount of electric power.

(c) It can be designed to least weight and smallest size.

(d) It contains fewer parts and assemblies, and is subjected to smaller loads on gears, motor, and housing.

(e) Even though designed for use with batteries, in a pinch it can be operated by auxiliary powerplants.

Inertia starters and combination electric inertia and direct cranking starters are much less satisfactory. In fact, the inertia starter – which consists of a flywheel in which energy is first stored either manually or electrically, then connected to the engine through a gear train – is generally unsuitable for large aircraft engines because insufficient starter speed is obtainable at low temperature.

With the combination starter, the initial cranking speed is the same as that of the inertia type, and the direct cranking speed is dependent on starter design and capacity of power supply.

Starting Requirements

In tackling the design of a starter system, one should analyze thoroughly the following factors, which have to be fulfilled to have successful starting:

1. The engine must be turned over with the starter.
2. A combustible mixture of vaporized fuel and air must be available in the cylinders.
3. An adequate spark must be produced.
4. The engine must develop sufficient power to overcome its friction and accelerate to operating speed.
5. The lubricant must have suitable flowability and viscosity to permit an adequate supply to the engine.

Mr. Beier deals mainly with the first requirement.

The first step in meeting this requirement is to determine the cranking torque, a factor affected by oil viscosity and cranking speed needed by the engine.

It is well known that oil viscosity rises at an increasing rate as temperature decreases, so that there is a definite maximum viscosity and corresponding minimum temperature at which it will be more economical to change to a lighter oil than to supply the necessary cranking power by increasing the starter size.

Since engines must operate under a wide temperature range and changing oil is impractical, it is commercial and military practice to reduce vis-

* Paper "Aircraft-Engine Starters," by Arthur Beier, Jack & Heintz Precision Industries, Inc., presented at SAE Summer Meeting, June 4, 1946.

cosity by diluting the oil during starting periods at low temperature.

As a result of extensive tests by aircraft-engine manufacturers, SAE committee E-16 has set the maximum practical cranking viscosity at 35,000 SUS, which corresponds to 26 and 33 F with grades 1100 and 1120 oil, respectively.

It appears, however, that although it is not the best practice, starts can actually be effected down to the engine oil pour point, which is between 5 and 10 F for grades 1100 and 1120, with a corresponding viscosity of 100,000-150,000 SUS.

The starter should be designed, therefore, for a peak efficiency at maximum normal load or the torque corresponding to that obtained using a 35,000 SUS oil at the desired cranking speed. It should also be capable of cranking the engine in an emergency at a temperature corresponding to the pour point of the oil. Thus, if the oil has not been diluted and a relatively large power supply is available, the engine can still be started.

Cranking Speed

The next question to be answered is how fast the starter should crank the engine. In evaluating the optimum cranking speed, best engineering practice will result if optimum cranking speed is considered to be the speed that will produce a start with *minimum dissipation of energy.*

A limited testing program indicates that 25 rpm will start engines with a minimum dissipation of energy. Further tests are expected to confirm this tentative figure.

In designing a starter two other factors must be considered. The first is the maximum cranking period that the electric motor will be called upon to perform. The Army and Navy have recently specified 6 min, although E-16 considers two 30-sec cranking periods ample. The author indicates that starter manufacturers can be expected to design to the 6-min requirement.

It is also necessary to consider the characteristics of the power supply. In this connection it should be pointed out that, although the starter could be designed for maximum efficiency at the voltage of the auxiliary power, it should be designed to give satisfactory performance with the plane batteries, as it is highly desirable to have the airplane self-sufficient.

Thus, since batteries represent the smallest source of power, their characteristics should be the determining factor in starter design.

As a practical application may be mentioned the design of a starter so versatile that it can be used on engines from 800 cu in. displacement up to the Wright R-3350 and P&W R-2800 class, thus permitting interchangeability and reducing starter cost. Maintenance of this direct cranking starter would be considerably less than those for other types because of greater dependability and simplicity of construction. Installed weight of the starter is only 27 lb.

The conditions already given for accomplishing starting of conventional engines also hold for the turbojets. The characteristics of these engines and the operational problems of their use, however, result in considerably different types of equipment.

In comparison with the 25 rpm considered optimum cranking speed for conventional engines, 3000-5000 rpm is necessary for starting speeds of turbojets, because, although jet units can be ignited and assist the starter at about 15% of rated speed, the unit is not self-sustaining until it reaches its minimum idling speed, which is about 30-45% of rated turbine speed.

The real objection to these high cranking speeds is the large power requirements that they represent. At 60 F one of the smallest turbojet engines, which develops 1500 hp at present airplane speeds, requires a starter having a peak output of 20 hp and a minimum output at the end of acceleration of 9 hp. In comparison, the conventional 2000-hp engine requires only about 2 hp. The moment of inertia of the jet engine used in this illustration was only 12 lb-ft^2. The large jet engines under development will have corresponding increases in starter power requirements. In fact, estimates indicate they will require starters of 150-200-hp output. Since the largest reciprocating engine requires a maximum of only 6½ hp, the starting means for jet engines must be given an entirely new analysis and consideration.

Starters being investigated for use of turbojet and gas turbine units include:

1. Electric starters, which have the advantage of being exceedingly reliable, simple in operation, and cheap to manufacture.
2. Internal-combustion engine starters have been developed by both British and German engineers with some degree of success. They could be considered only for small jet engines, as the power requirements of the large jet engines being developed are too high for these starters.
3. Steam or compressed air starters have the advantage of high output per unit of weight.
4. Gas turbines are also being designed, but many difficulties exist in developing a low-horsepower unit for this purpose.
5. Hydraulic motor and pump type offers extreme high power per unit of weight and space, however, the hydraulic fluid would have to be stored externally to eliminate the weight and space requirements of the accumulator and oil system.
6. Cartridge type of starter involves the use of a slow-burning power to develop gas pressure to drive a small turbine unit. Such a unit is extremely light and capable of being made self-sufficient for sea-level and altitude operation.

Extensive developments are needed to perfect a really satisfactory method of starting turbojet and gas turbine units. In the meantime, electric starters will be used because they are the simplest and most reliable units now available.

GEAR Lubrication

A Symposium*, Including a CRC-CLR Progress Report, and a Paper on Low-Speed, High-Torque and Another on High-Speed Testing of Gear Lubricants for Hypoid Axles

A condensation of these three papers and a discussion by H. R. Wolf, Research Laboratories Division, General Motors Corp., are presented herewith.

An important technical wartime service performed for the Army Ordnance Department was the devising of tests to define Universal Gear Lubricants by the Coordinating Lubricants Research Committee of CRC. "Recent Developments in Universal Gear Lubricants," by P. V. Keyser, director of Gear Oil Projects of CRC, and research director of Socony-Vacuum Oil Co., Inc., is the CRC's official report on that subject.

"Low-Speed, High-Torque Testing of Gear Lubricants for Hypoid Axles," by A. O. Willey, Lubri-Zol Corp., describes the need for such a test procedure, and points out that the U. S. Army's Specification 2-105B, which was developed by Keyser's group, fulfills this need, and should be continued in use.

Also adapted for high-speed testing, this specification is further described in that area in a paper "High Speed Testing of Gear Lubricants for Hypoid Axles," by C. E. Zwahl, metallurgical engineer, Chevrolet Motor Division, General Motors Corp. It stems from some 15 years of development and experience in the automotive industry.

How Army's Universal Gear Oil Specification Was Developed

WHEN the Army decided in 1940 to use one gear oil for all types of automotive gear drives several all-purpose oils were in commercial use, Keyser recalled in presenting the Coordinating Lubricants Research Committee's report. Unfortunately, there was no established test, or group of tests, which were flexible enough to cover the several types in one specification without making it so loosely definitive as to admit unsuitable lubricants.

One, using a sulfur-chloride addition agent, had wide acceptance, and its production could be immediately expanded. A large automobile company, in collaboration with several refiners, had prepared a fairly complete specification for this lubricant. In face of the impending emergency, that specifica-

* Presented June 7 at the SAE 1946 Summer Meeting, French Lick, Ind.

tion was used as the basis of the original Universal Gear Lubricant Specification, first as Federal Specification VVL-761, which later was known as Army Specification 2-105.

Because this specification excluded the products of other refiners which had satisfactory commercial records, and because it had a tendency to deposit sludge at operating temperatures above 225 F, the Army Ordnance Department requested the Coordinating Research Council to improve the test method included in that specification, or develop new tests around which a new, non-restrictive specification could be written.

Experience had proved that the indications of load-carrying ability by several accepted laboratory Extreme Pressure machines could not be depended upon, unless:

- The type of additive was specified, and
- A definite range of values was set up for each.

Because of the tremendous amount of work entailed in such an investigation, these ranges had never been clearly defined.

Lubricant performance in actual gear drives is the only criterion by which all types of additive lubricants can be evaluated. Although the then current specification embraced tests of that nature, they were developed from a single automotive manufacturers qualification procedure, and whether they fully evaluated those lubricant characteristics most required by the Armed Services was doubtful. It was recognized that too stringent requirements were about as dangerous as lax ones.

Road tests on representative military vehicles were carried out at the Aberdeen Proving Ground and at Camp Seeley, Calif., to supplant conjecture. Each of the test lubricants represented a definite type of E. P. additive and, in some cases, different additive concentrations.

High-speed data thus obtained defined the level of severity of Army use in respect to gear scoring. This formed the basis of a new high-speed gear test, which appears in the Army Specification 2-150B.

General characteristics of Grades 75, 80, and 90, covered by this specification, are:

Viscosities of the 80 and 90 grades remain unchanged from those of Specification 2-105. Viscosity of the 75 grade at 100 F has been increased, that at −50 F has been removed, and a viscosity index has been specified. Viscosity of the latter grade is being reviewed by the CRC group in charge of this project.

Flash Point, minimum, was included. This was a new feature in the Army lubricant specification. Omission of a laboratory stability test was agreed upon because the group was unable to find or devise a test that could be correlated with service experience. The High-Torque, Low-Speed Axle Test provides a direct evaluation of stability both in respect to sludge deposits and corrosive action.

Channel Points for the 80 and 90 grades remain unchanged. A channel point of −50 F was recommended for the 75 grade, rather than a pour point.

Copper Strip Activity test is now confined to a temperature of 250 F. The test has been modified to provide better reproducibility.

Rust Protection Test replaces the steel strip corrosion test of the earlier Army specification.

Laboratory E. P. Machine Tests have been eliminated in the new Army Specification, because different types of lubricants which passed the severe axle service tests gave SAE E. P. lubricants machines load-carrying capacity figures ranging from less than 30 to 350 lb. Representative values on this and the Timken machines were recommended to be given for record purposes, however.

Qualification Tests, on the basis of which the Ordnance Gear Oil Reviewing Committee recommends Army acceptance or rejection of lubricants, includes these tests:

High speed road; high torque; moisture corrosion; storage solubility, and foaming.

Because of the elaborate and expensive axle tests required by the Army's qualification test program, and the limited availability of equipment – particularly for the High-Torque Test – the CLR Committee recommended that additive qualification tests be confined to the 90 grade only. The Aberdeen and Camp Seeley tests indicated the validity of this decision.

To eliminate unnecessary qualification testing it was suggested by the advisory group that, at the option of the Ordnance Department, finished universal gear lubricants using base stock components similar to those used in previous qualified lubricants and compounded with the same additive in the same percentage, be accepted without further testing.

■ ■

Low-Speed, High-Torque Testing

DETAILED description of the four-square machine, to test gear lubricants under simulated service conditions, was presented by A. O. Willey, director of engineering, Lubri-Zol Corp.

The machine employs two rear axle assemblies. One of these is under test while the other serves to complete the power transfer circuit. The load is applied by winding up the system through one of the corner gear boxes until the desired torque is obtained. The complete assembly is rotated by an electric motor geared to one of the shafts.

Another type of installation explained by the author uses a single rear axle with high capacity absorption dynamometers coupled to each of the axle shafts. Power impact to provide the specified load is supplied by an electric motor connected directly to the axle drive shaft.

The unit the author used as an example in his paper was a new ¾ ton Army truck hypoid rear

axle carrier with a 5.83:1 ratio. It was supplied by the manufacturer as a complete assembly, and no changes or adjustments were permitted. Backlash measurements were obtained with a dial gage.

The carrier is then installed in the housing, and the torque required to rotate the pinion shaft is measured with a torque wrench. This effort is the sum of the resistance of the bearings, gears, and lubricant seals under no load condition.

Then the gear housing is filled with the test lubricant. A recording potentiometer with limit switches operates a solenoid valve in the cooling water supply line to automatically cycle the lubricant temperature between 200 and 250 F. Heating and cooling curves thus derived reflect the performance of the lubricant under test.

Photoelectric cells, mounted in an adjustable arm in front of the scale dial, maintain uniformity of load on each of the two axle shafts. A small mirror fastened to the load indicating pointer actuates the photoelectric cells, which in turn control the rheostats in the dynamometer fields. Thus the load on both dynamometers is automatically maintained to less than 0.5% variation.

Following a 20-min breakin run at reduced load and temperature, conditions are adjusted to the value of 62 rpm ring gear speed and 32,311 in.-lb ring gear torque, as called for in the procedure. Lubricant temperature is allowed to be built up to 250 F, and at this point the cooling water is turned on and the temperature is dropped to 200 F. This cooling cycle is continued throughout the 30 hr test.

When the test is finished, the axle carrier is removed from its housing. Torque of the pinion gear is taken both when the carrier is hot and after it again reaches room temperature. Increase in this torque over that recorded at the beginning of the test indicates that deposits restrict the free motion of gears and bearings. Backlash between ring and pinion gear teeth is checked for comparison with the readings found previously when the unit was new. Excessive wear of contact areas will show as abnormal increase in backlash.

■ ■

High-Speed Testing

SIMULATION of high-speed road testing of rear axles by a laboratory method has been achieved during the past 15 years during which the automotive industry has developed a number of variations of a method developed by General Motors Corp., Packard Motor Car Co. on their proving grounds, and one by Chrysler Corp. in a 200-mi city to city run, C. E. Zwahl, metallurgical engineer, Chevrolet Central Office engineering department reported.

These tests, backed by the experience gained over the years, form the basis of the test procedure approved by the Army Ordnance Department and which is included in Army Specification 2-105B.

This includes a continuous high speed run over a distance of 38 miles at 75 mph, followed by a shock test. A modification of tests used by industry, Part 4 of the Army's procedure, in brief, follows:

The test conditions and procedures for the road test shall be as outlined below. The same procedure may be followed on a chassis dynamometer, provided that the roll torque throughout the entire speed range and the kinetic energy of the rolls at 70.2 mph are identical with the effective road conditions and proven for any given installation by check evaluations.

(a) Run five to 25 miles at not over 25 mph.

(b) Engage the clutch in high gear and accelerate (full throttle) to 40 mph. Upon reaching 40 mph, close the throttle and coast to 10 mph with the clutch engaged. Repeat for a total of four times. Gradually accelerate in high gear to 60 mph. Upon reaching 60 mph open the throttle wide and accelerate to 80 mph. Immediately close the throttle completely and coast to 60 mph with clutch engaged. Repeat the drive and coast between 60 and 80 mph for a total of ten times.

(c) Return the vehicle to the inspection point at not over 25 mph.

(d) Drain the test lubricant and remove the third member assembly.

(e) If under inspection there is no scoring of the ring and pinion gear teeth in the original test, a duplicate test shall be made using fresh lubricant and a new and unused third member assembly. If scoring of the ring gear or pinion teeth occurs in any test and is attributed to abnormal conditions, that test shall be voided, and the test shall be rerun using fresh lubricant and a new and unused third member assembly.

Mr. Zwahl pointed out that state speed laws inhibit road testing at high speeds, although the Chrysler run from Detroit to Bay City, Mich., and return has been a successful test. There are no top speed limits in that state and 75 mph and higher can be made on that run.

This part of the Army specification was also developed by the CRC's Gear Lubricants Advisory Group, enlarged to write a high speed test procedure for gear lubricants for hypoid gears at the request of the Army Ordnance Department.

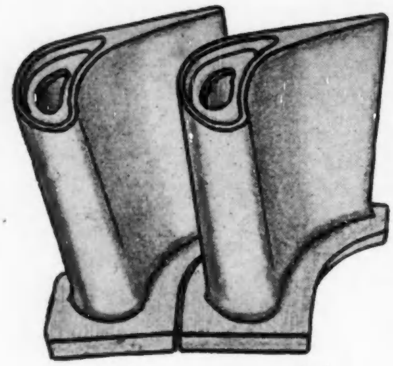
Discussion by H. R. Wolf

WILL gear oils that meet the requirements of the U. S. Army Specification 2-105B function satisfactorily in passenger car hypoid axles and in heavy-duty truck and commercial vehicle hypoid axles for the initial factory fill and/or under service conditions?

Mr. Keyser pointed out that the Army Ordnance

continued on page 96

Blade Structure


(a)


1 (b)

Hollow blades are better than solid ones as they permit boundary layer control without the thick sections that might reduce efficiency. For high-speed airfoils hollow blades are desirable because of their low weight, high strength, and adequate stiffness at the trailing edge.

By reducing centrifugal force on drums and permitting internal cooling by air or other fluids, hollow blades offer a real saving in engine weight.

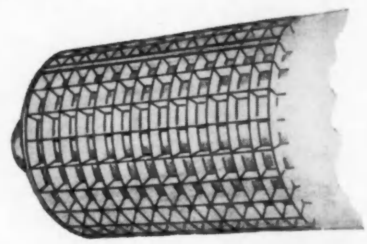
Shown in (a) are sheet metal blades of constant wall thickness. They can withstand a tip speed of well over 1300 fps – in excess of axial flow requirements. Wall section of turbine bucket in (b) is tapered in the ratio of 2:1, well within limits of creep and hot rupture-stress.

To prevent loss of efficiency in service, a hard, erosion-resistant material is best for compressor blades.

How T

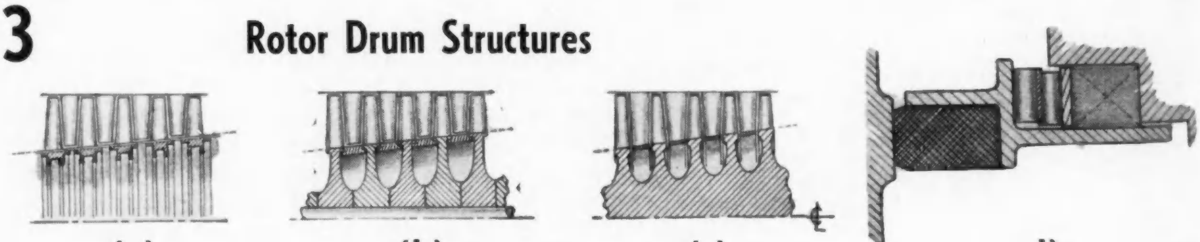
Compressor Casings

2



This type of deep box ribbing assists in maintaining uniformly close compressor-blade tip clearances. Cool air flow along the outside of the compressor casing has some effect on casing diameter and merits consideration in specific installations.

3 Rotor Drum Structures


(a) (b) (c) d)

Internal cooling is the only way to offset thermal expansion effect on blade clearance. The drum in (a), consisting of a surface shell with internal tension hoops, has unusually high flexural rigidity. Hoops and shell do not become overstressed in impulse-type compressors operating at low rotating speeds.

Suitable for long drums with relatively high rotating speeds is the drum with discs alternating with rotating ring spacers, shown in (b). Rotors machined with disc-like extensions with a solid center forging, shown in (c), can withstand the highest rotating speeds.

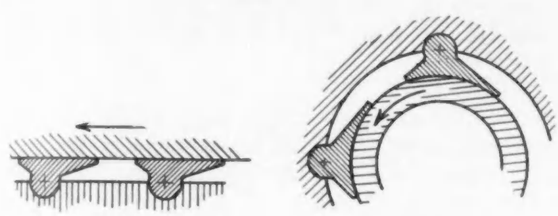
To keep power leakage to a minimum in a small available space, the carbon type seal is recommended. Properly balanced carbon seals, shown in (d), can be operated dry at relatively high temperatures with polished steel surfaces at rubbing speeds of several hundred feet per second.

Tailor Gas Turbine Elements to the Job

FROM A PAPER BY **N. C. PRICE***

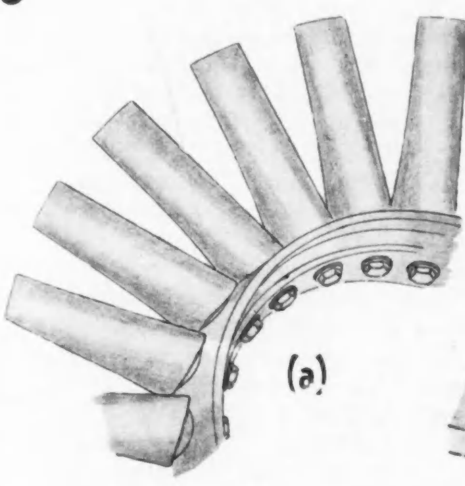
* Paper "Mechanical Design Considerations Influencing Blading Performance in Aircraft Gas Turbine Powerplants," by N. C. Price, Menasco Mfg. Co., was presented at SAE Annual Meeting, Jan. 9, 1946.

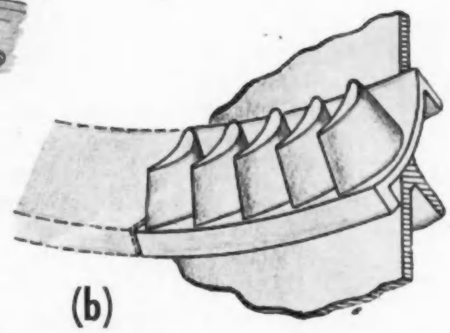
4 Bearings

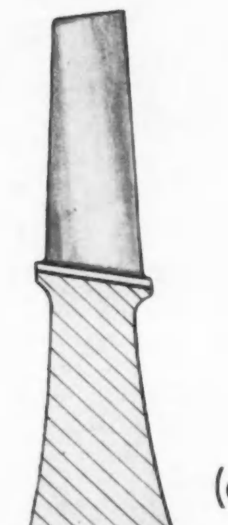


Bearings effect compressor performance by determining what tip speed clearances may be maintained with accurate concentricity of rotor drum in casing. These slipper bearings keep small clearances (0.001 in. per in. of journal diameter) at rubbing speeds of several hundred feet per second without over-heating. Their load-carrying capacity is well over 10,000 psi of projected area using light oil.

5 Blading Attachments







In turbine wheels or casings surface diameters may be enlarged in the outflow direction in comparatively abrupt steps at each stage outlet without ill effect. This does not hold for axial flow compressors; here great care should be taken in maintaining a smooth surface transition between casing, compressor drum, and blade bases as in the test blading in (a).

An interesting method of mounting intermediate vanes in turbine cases, as shown in (b), is to use the cast segment method. It allows differential expansion to take place in small gaps between the adjacent backing plates.

That electric resistance welds of bucket base to wheel are attractive is apparent from (c). Good conformity with turbine wheel surface is obtained, keeping the amount of inactive structural material to a minimum.

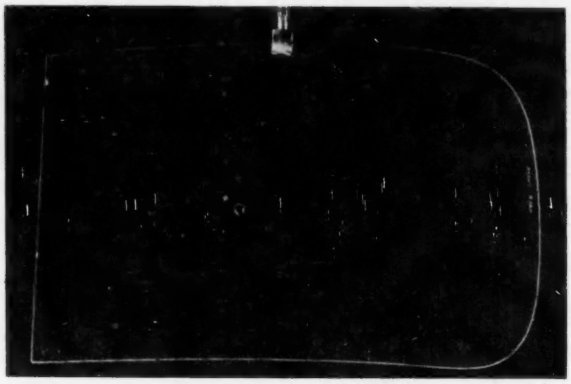


Fig. 1—This is how a Plexiglas half windshield looked after being subjected to 2½ hr of wiper operation during 48 days of driving

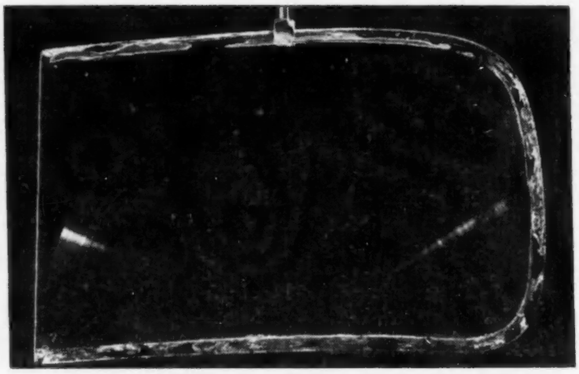
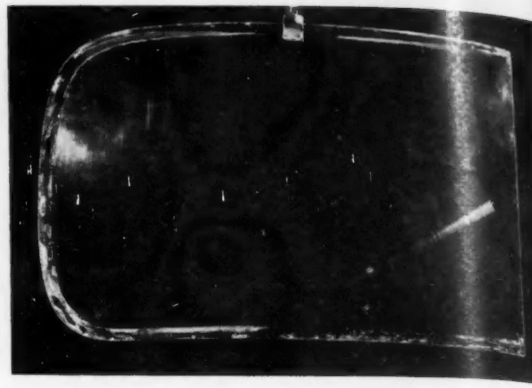


Fig. 2—CR-39 holds up a little better than Plexiglas. This CR-39 windshield half was installed in a Buick for 65 days during which the car was driven 2000 miles and the wiper operated 2½ hr



For Car Windows

TRANSPARENT plastics have some advantages over safety glass for motor vehicle windows, Libbey-Owens-Ford tests show, but certain undesirable characteristics revealed make them impractical for general glazing application.

Good qualities of these materials, originally developed before World War II, include light weight and ease of fabricating complicated shapes. Important among the undesirable qualities – as regards vehicle applications – are rapid surface deterioration (which impairs visibility), rattling, and difficulty in cleaning.

The tests by which Libbey-Owens-Ford arrived at its evaluations were made with three types of plastics – Lucite, Plexiglas, and CR-39. Plastic windows were installed in Buick Sedans and subjected to normal day-to-day driving. To complete the picture, a similar check was made using conventional safety glass. Following is a summary of conclusions drawn from field test results:

Life of Plexiglas or Lucite in the windshield under average operating conditions – using the wiper occasionally – ranges from 30 to 45 days. Beyond the 30-day period driving with the abraded windshield is dangerous. It was difficult in making turns to ascertain the location of the curb or whether or not a pedestrian was standing on the curb or in the highway.

As the surface of the windshield deteriorated due to the rubbing action of the windshield wiper, it was almost impossible to drive into the sun or bright headlights at night. Further, a very annoying halo and streamer effect was observed when viewing street lights, illuminated window signs, and other lighted displays through abraded area.

Fig. 1 shows a Plexiglas half windshield after 48 days of service during which time the wiper was used 2½ hr. Windshields of CR-39 last a while longer, but not much. Their life is at best not more than 60 to 180 days. After 65 days of service in which the car was driven 2000 miles, the wear shown in Fig. 2 resulted.

Safety plate glass windshields, from the standpoint of vision, are far superior after three to four years' service to any of the three plastics after only a few weeks' service. Compare the safety plate glass windshield in Fig. 3 that was in a car over four years through 40,000 miles of driving with those in Figs. 1 and 2. The slight amount of scratching accumulated on safety glass windows over three to four years of use in an automobile is not visible looking directly through the windshield.

Surface deterioration in plastics is not confined to windshield applications. Plastic body windows also showed wear, though not to the extent of plastic windshields. Shown in Fig. 4 are a Lucite front ventilator and front door window after service for one year.

None of the scratches in body window glazings (excluding windshields) was so annoying that replacement of plastic was imperative in one year.

Tests show these three plastics to be consider-

* Paper "Automotive Glazing with Plastics" by G. B. Watkins and J. D. Ryan, Libbey-Owens-Ford Glass Co., was presented at SAE Summer Meeting on June 4, 1946.

Fig. 3—Though in use over four years, through 40,000 miles of driving, this safety glass windshield half is relatively free of abrasion

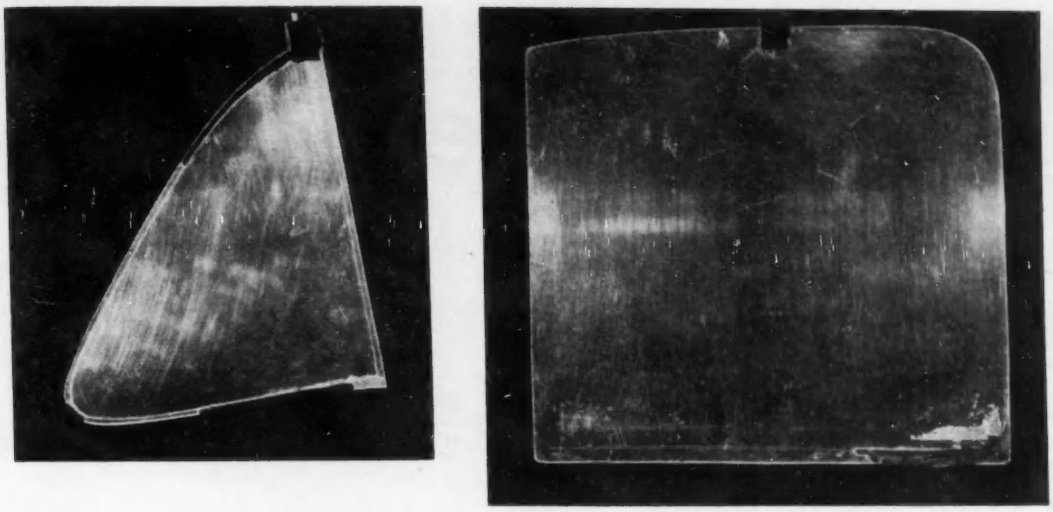


Fig. 4—The Lucite front ventilator at right and front door window, far right, were in service for one year. Scratches were not bad enough to warrant replacement of the plastic

–Plastic or Glass?

From a paper by

G. B. WATKINS and J. D. Ryan*

ably more resistant to impact than ordinary sheet or plate glass; to that extent they make safer automotive windows. But when ruptured, sharp dagger-like particles just as hazardous as glass are produced. In this respect CR-39 is more undesirable than Lucite or Plexiglas since more fragments are formed for a given impact.

This is demonstrated by Fig. 5 which shows the remains of a CR-39 specimen after an 11-lb shot-bag impact from 8 ft as compared to the results of the same test from 20 ft on a Plexiglas specimen.

There is a greater tendency for plastic glazings to rattle. Especially is this true when the door window is partially lowered. Reason for the rattling is the greater resiliency of the plastic – it gives a whipping action when the car is in motion or during closing of the car doors.

Another undesirable feature of plastic windshields is low thermal conductivity. The heater does not melt ice and snow as rapidly as in the case of laminated glass. In one test car using a plastic windshield during the winter, sleet and ice formed could be removed only by pouring hot water over the windshield since it could not be scraped off without materially damaging the surface.

Plastics are extremely difficult to clean. Road scum does not wash off as readily as from glass surfaces. In wiping the plastic dry, annoying static developed on the surface picks up dust.

Polishing and cleaning agents such as rouge and Bon Ami instantly scratch all of these plastics.

Water did not wet the plastic windshields to the same extent as it does glass, tending to stand up in droplets that the windshield wiper did not readily remove. Vision was also hampered by these water droplets on the other windows. Plexiglas and Lucite are greater offenders in this respect than is CR-39.

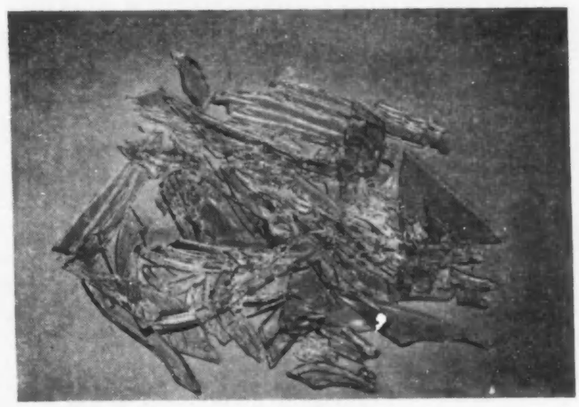
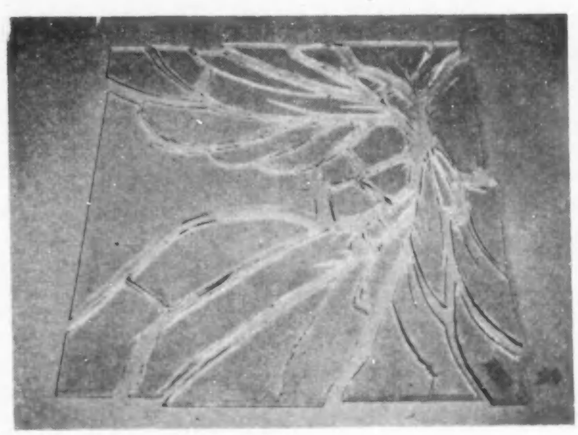


Fig. 5—Tests showed CR-39 splinters to be more dangerous than those from Plexiglas. Dropping an 11-lb shot bag from 8 ft on a ¼ in. specimen of CR-39 gave results shown in photograph above; photograph below shows the effect of dropping the same weight from 20 ft on a Plexiglas specimen ¼ in. thick



Engineers Face Economics In Transport Studies . . .

Warren A. Taussig, chairman of the General Committee (left), with Ray D. Kelly and E. N. Hatch, SAE vice-president, members of the group which planned and staged the Chicago T&M Meeting

SEARCHING engineering developments in metallurgy, aeronautics, and other fields of accelerated technical thinking, the SAE National Transportation & Maintenance Meeting focused attention of vehicle fleet operators and equipment design engineers on tomorrow's economics at the two-day Chicago event, Oct. 16 and 17.

In reiterating the meeting's keynote, SAE President L. Ray Buckendale told the dinner audience at the end of the opening day, Oct. 16, that "From here on in, time, men, materials, and brains must produce the most for the least.

"This is economic realism," he concluded.

Prewar years showed no German engineering development in either passenger cars or trucks, according to A. M. Wolf, consulting engineer, who reported his observations as a member of the automotive subcommittee of the Technical Industrial Intelligence Committee which visited that country late last year.

Manufacturing Under American Licenses

Many components and accessories were manufactured under American licenses, although originality was shown in suspensions and axles – sharp contrast to this country's "frozen" designs, he told his dinner audience. Relatively small production permits considerable variation in body designs.

Germany did not produce what might be termed "middle-priced" automobiles. Low priced cars had none of the niceties demanded by the American owner, although the high-priced vehicles suffered no criticism on this score. "Germany," he said, "has been a designer's paradise," because of this fact.

Standardization of gear shift position, truck ratings, frame widths and other items leaves much to be done, Wolf reported.

"Unlike the situation in this country, makers of component parts and accessories have done little development work. Most of them had no basic engineering data in their files, which would be needed by their counterparts in this country," he said.

Equipment Pays for Itself

At the opening session, devoted to dynamometer equipment in fleet garages, F. C. Patton, Los Angeles Motor Coach Lines, agreed with Paul Oberreutter, Mid-West Dynamometer & Engineering Co., that such equipment in the hands of trained personnel pays for itself quickly. Both the chassis and engine dynamometer, whether hydraulic or electric, are needed in any fleet shop where considerable engine rebuilding is done, the former wrote in his paper, "The Dynamometer as an Aid in Fleet Maintenance – Operator's Viewpoint."

The purpose of the chassis dynamometer is to duplicate standards set by road testing of vehicles, M. C. Horine, Mack Mfg. Corp., pointed out in dis-

cussion. But to do this, the operator of the test equipment must understand its "language," and be able to interpret its findings.

"If the operator of the equipment does not do this, the dynamometer will do more harm than good," he predicted.

Session Chairman E. N. Hatch, SAE vice-president for T&M, reported that he had found the test equipment valuable in checking complaints about insufficient power of vehicles. However, dynamometers would be more valuable if determination of the correct rolling resistance could be determined, he said.

Adequate instrumentation in fleet garages was stressed by Lee Oldfield, Laboratory Equipment Supply Corp. president. Estimating the condition of vehicles is a costly procedure.

Agreeing with the sense of the meeting, Gavin W. Laurie, Atlantic Refining Co., thought that a fleet of 100 trucks would justify the installation of a chassis dynamometer by the operator. However, with a scattered fleet he questioned the advisability of buying as many test machines as would be required to check all the units in such a fleet. In general, he said, the cost of deadheading trucks to centralized service shops is rising.

M. E. Nuttila, Cities Service Oil Co., faces the same problem posed by Laurie. He finds it impossible to pick a suitable location for a dynamometer installation.

The afternoon session, under the chairmanship of E. P. Gohn, swung off to a lively discussion following two papers on vehicle space heating. Lewis A. Rodert, South Wind Division, Stewart-Warner Corp., stated that heated walls, fog-proof windows, and draftless ventilation of vehicles are on the way in his paper on "Fresh Air Automotive Heating: Influence of Aviation Industry."

"The essential features of airplane heating design have been proven to be good," he said, explaining three basic methods in which this had been accomplished.

"Air flow rates are below 30 cfm per person, and well within the range of practicability for automobiles," he reported.

"Automotive Space Conditioning" was the subject chosen by E. T. Todd and F. O. Gadd, GMC Truck & Coach Division, General Motors Corp. Priority on heating, ventilating, and air cooling of vehicles as an immediate postwar development has been set by motorcoach manufacturers, and they explained what had been done in this area to date.

Important Considerations

The three most important considerations of passenger comfort, they said, were:

- A feeling of pleasure upon entering the coach followed shortly by an unawareness of the temperature;
- Complete absence of odors, and
- Good visibility, even in the coldest winter weather.

They explained in detail how a single solution can be made to achieve these ends with the use of an auxiliary water heating system.

A great deal of experience has been gained during the war emergency by the aircraft industry in the use of combustion type heaters, Phillip Miller, Surface Combustion Co., reported. He felt that the trend in the transportation industry was toward this type of heater.

Warren A. Taussig, chairman of the meeting's general committee and automotive engineer with the Burlington Transportation Co., pointed out that the water heater system aids in control of engine heat as well. If costs and size can be reduced, and more simplicity achieved in design, the field of truck cab improvement will be well on its way.

At full capacity the heater described by Messrs.

O. A. Brouer, brilliant toastmaster of the National T&M Meeting (left) with W. H. Oldacre, Section chairman; SAE President L. Ray Buckendale, and Austin M. Wolf, dinner speaker

Todd and Gadd consumes ¾ gal of fuel per hr. With an output of 75,000 Btu an efficiency of 74% is achieved, Todd replied to a question by Horine. As to electrical draw, a question about which was asked by F. K. Glynn, American Telephone & Telegraph Co., the author said that there is a net gain over the three or four individual heaters used on older equipment.

As to overall fuel economy, Todd said that tests to date appear to be too good to be true, and was unwilling to release figures now. With the built up engine heat as an aid to cold starting and efficient engine operation, the authors thought there would be little or no increase in fuel consumption.

Aluminum and stainless steel came in for lively discussion following three papers at the Thursday morning session, which was presided over by Taussig. Again the keynote of changing economics predominated papers and discussions.

The experience of the Dayton Power & Light Co., as reported by F. O. Lewis of that utility company, is that light weight bodies on trucks pay dividends. Data of costs presented were on overhead line construction trucks of 6000 lb capacity.

Pointing out that the total operating costs of these vehicles throughout their lives is three times the original cost, he concluded that a little more capital investment to obtain more economical operation saves money.

Savings with Light Metal Bodies

J. H. Dunn, Aluminum Co. of America, pointed out that operators of vehicles with light metal bodies have reported savings in gasoline consumption and tires, better acceleration, improved hill climbing, better maneuverability and, in many cases, lower license fees.

Reduced costs of painting the vehicle also result from the use of aluminum as a body material. Some operators reported that they seldom or never paint their aluminum bodies. In the case of aluminum bodies, Dunn pointed out, where the light metal and steel sections come in contact, both metals should be carefully painted with zinc chromate primer and he suggested further protection against galvanic action by using an acceptable plastic material. This action is quickly observed when the joint is moist.

Magnesium sheets, tubing, forgings, extrusions, and castings should be painted, however. Although the material forms well when hot, it cannot be handled cold unless the radii at bends are liberal.

For vehicles hauling foods, the author felt that the nontoxic characteristic of aluminum makes it an ideal body metal. Neither aluminum nor magnesium sparks, which makes them ideal for bodies hauling inflammables.

From the standpoint of deadweight reduction, or to increase load carrying capacity without increasing body weight, stainless steels have demonstrated their economic value in the motor haulage business for the past 10 years, V. M. Drew, Fruehauf Trailer Co., the third author of the symposium, reported.

He warned that stainless steels offer some difficulties in repair, but outlined techniques to properly handle the material.

However, it was pointed out in discussion that a great deal has been learned in recent years with respect to repairing stainless and other high alloy steels. "It is just as easy to learn the technique of working with stainless as it was to learn how to handle low carbon sheets," one operator said in discussion.

Wolf, in discussion, pointed out that changing economics force the operator to continually review the problem of body materials, and predicted a wide use of lighter materials for this purpose in the future.

F. K. Glynn opened the Thursday afternoon session in the absence of D. K. Wilson. The speaker was Ben Sorci, Sorci & Bryant, who pointed out that the trouble with tire maintenance today is that it is usually considered a minor problem by the fleet operator, and the work of tire repairing is left to a man who is never permitted to participate in policy questions of the company.

Disinterest Causes Troubles

Tire maintenance cannot succeed unless top management realizes that most of the troubles, and hence excessive costs of tire maintenance, result from his own disinterest, from the lack of understanding of the first price versus repair cost by the purchasing department, personnel manager's disinterest in how a prospective driver will treat tires, and a general lack of coordination of other departments.

Setting up a tire maintenance department, and letting the problem rest there, is bound to be costly, Sorci pointed out. Setting up a shop procedure, and following it blindly, will never be economical.

He presented in detail a plan in which policy and routine operations are coordinated with the management of the fleet owner, whether the fleet is owned by a manufacturer and distributor of goods or services, or is operated by a common carrier or a bus line.

Operators were advised to set up rigid requirements of quality to which the recapper agrees, and make him live up to it, the author believes that recapping cannot be done cheaply, and the number of rejections and not high price, should determine the recapper who gets a fleet's business.

"When an operator is recapping and running successfully a large percentage of his tires, he has achieved success," he continued.

If an operator plans his fleet maintenance carefully, he can demonstrate to his management that the 100,000-mile tire is here now, he asserted.

"It is far cheaper to run tires properly than to accept 'policy adjustments' when they blow out," he concluded.

COMING S.A.E. EVENTS

NATIONAL MEETINGS

MEETING	DATE	HOTEL & CITY
Air Transport Engineering	Dec. 2-4	Edgewater Beach Chicago
Annual	Jan. 6-10	Book-Cadillac Detroit
Aeronautic	April 9-11	New Yorker New York

(Details about meetings appear on following pages)

SAE 1947 A·N·N·U·A·L M

Book-Cadillac Hotel
Detroit

JANUARY 6-10

MONDAY, JANUARY 6

10:00 a. m. **Transportation & Maintenance**

Energy Absorbers Auxiliary to Brakes
– J. G. Oetzel, Warner Electric Brake Mfg. Co.

10:00 a. m. **Aircraft Powerplant**

Fuel Metering by Engine Speed and Manifold Density
– J. A. Bolt, Bendix Products Div., Bendix Aviation Corp.

Fuel Injection Systems for Light Aircraft
– G. M. Lange, Ex-Cell-O Corp.

10:00 a. m. **Materials**

Scuff and Wear Resistant Chemical Coatings
– F. C. Young and B. B. Davis, Ford Motor Co.

Automotive Adhesives and Sealers
– A. J. Carter, Chrysler Corp.

2:00 p. m. **Transportation and Maintenance**

Two-Way Radio Telephone Communication for Use in Automotive Fleets (Progress Report of SAE Committee on Radio Communications Suitable for Automotive Fleet Application)
– W. C. Baylis, N. Y. Power & Light Corp.

2:00 p. m. **Aircraft Powerplant**

Crankshaft Bending Vibration
– E. F. Critchlow, Civil Aeronautics Administration, and W. T. Bean, Jr., Continental Aviation and Engineering Corp.

Propeller Requirements for Light Aircraft
– J. H. Haines, Aeroproducts Div., General Motors Corp.

2:00 p. m. **Materials**

Is There a Relation Between Metallurgy, Engineering and Materials Specifications?
– F. G. Tatnall, Baldwin Locomotive Works

The Manufacture of Precision Castings
–Gosta Vennerholm and E. E. Ensign, Ford Motor Co.

8:00 p. m. **Body and Junior Student**

Odd Problems at High Speeds
– R. A. Railton, Consulting Engineer (As interviewed by D. G. Roos, interrogator)

TUESDAY, JANUARY 7

10:00 a. m. **Truck and Bus**

Designing for Higher Output in Gasoline Engines

Considerations in Valve Gear Design
– V. C. Young, Wilcox-Rich Div., Eaton Manufacturing Co.

Superchargers for Gasoline Engines
–R. L. Weider, White Motor Co.

10:00 a. m. **Aircraft Powerplant**

The Atmosphere and Its Predicted Effects on Turbine Type Aircraft Engines
– A. Dolinsky and F. W. Disch, Boeing Aircraft Co.

Study of Fuel Systems for Jet Aircraft
– W. H. Curtis and P. J. Lansing, Thompson Products, Inc.

10:00 a. m. **Passenger Car**

The Development of the Skinner Slide Valve Engine
– R. L. Skinner, Skinner Motors, Inc.

Production of the Jack and Heintz Engine
– R. M. Heintz, Jack & Heintz Precision Industries, Inc.

Copper Brazed Crosley Motors
– Paul Klotsch, Crosley Motors, Inc.

12:00-1:30 p. m. **Buffet Lunch**
Washington Room

2:00 p. m. **Truck and Bus**

Designing for Higher Output in Gasoline Engines
(continuation of 10:00 a. m. session)

An Approach to the Selection of Compression Ratio as Related to Fuel Quality
– E. J. Gay and H. T. Mueller, Ethyl Corp.

The Trend in Combustion Chambers and Fuel Systems
– A. T. Colwell, Thompson Products, Inc., and Alex Taub, Consulting Engineer to Thompson Products, Inc.

2:00 p. m. **Aircraft Powerplant**

O-Ring Seals in the Design of Hydraulic Mechanisms
– D. R. Pearl, Hamilton Standard Propellers Div., United Aircraft Corp.

Mean Specific Heats for the Working Media of Gas Turbine Powerplants
– N. A. Hall, United Aircraft Corp.

Stresses in Rotating Discs by Radius of Curvature Integration
– C. M. McDowell, Packard Motor Car Co.

NACA Study of Measurement of Piston-Ring Radial-Pressure Distribution
– M. C. Shaw, C. D. Strang, and O. W.

Meeting

and

ENGINEERING DISPLAY

Dinner Speaker . . .

Toastmaster . . .

ANNUAL MEETING DINNER

Detroit Masonic Temple
500 Temple Street

JANUARY 8

Speakers: W. AVERELL HARRIMAN – the new Secretary of Commerce will discuss industry's role in the nation's expanding economy . . . and the engineer's part in that expansion.

L. Ray Buckendale, President, SAE . . . . SAE President-Elect C. E. Frudden

Hart, National Advisory Committee for Aeronautics

2:00 p. m. **Body**

Modern Coach Structures
– H. E. Fox, Truck & Coach Div., General Motors Corp.

Modern Plastics as Applied to Automotive Transportation
– F. B. Stanley, Modern Plastics

8:00 p. m. **Business Session**

8:15 p. m. **Aircraft Powerplant**

Engineering and Research Planning in the Army Air Forces
Engineering Division, Air Materiel Command
– Major-General L. C. Craigie

WEDNESDAY, JANUARY 8

10:00 a. m. **Diesel Engine**

Must Diesel Engines Smoke?
– P. H. Schweitzer, Pennsylvania State College – Prepared discussion by: F. G. Shoemaker, Detroit Diesel Engine Div., General Motors Corp.

Flame Temperature Measurements – Electronic Solution of the Temperature Equations
– P. S. Myers and O. A. Uyehara, University of Wisconsin – Prepared discussion by: E. W. Landen, Caterpillar Tractor Co.

Analysis of Positive Supercharger Losses
– R. J. S. Pigott, Gulf Research and Development Co. (To be presented by B. R. Walsh, Gulf Research and Development Co.)

10:00 a. m. **Aircraft Powerplant**

Symposium – Cold-Weather Operation:

Cold-Weather Operation of Aircraft Powerplants by the United States Navy
– A. K. Forney, Bureau of Aeronautics, Navy Department

Aircraft Engine Starting Tests and Experiences in the Arctic
– William Weitzen and R. G. Dunn, Air Materiel Command, Wright Field

Cold Starting Characteristics of the Cyclone Engine
– G. A. Bleyle, Wright Aeronautical Corp.

10:00 a. m. **Passenger Car**

Heating and Ventilation Design Factors in Automobiles
– L. A. Rodert, National Advisory Committee for Aeronautics

Rubber – Will We Make It or Take a Chance?
– J. E. Hale, Firestone Tire & Rubber Co.

12:00-1:30 p. m. **Buffet Lunch**
Washington Room

2:00 p. m. **Horning Memorial Lecture**

The Mutual Adaptation of Aircraft Fuels and Aircraft Engines
– S. D. Heron, Consulting Engineer

2:00 p. m. **Passenger Car**

How Light Is Light in the Passenger Car Field?
– W. D. Appel, Willys-Overland Motors, Inc.

Rear Individual Wheel Suspensions – American and Foreign
– A. M. Wolf, Consulting Engineer

THURSDAY, JANUARY 9

10:00 a. m. **Aircraft**

Symposium—Light-Weight Sandwich Construction

Sandwich Materials: Metal Faces Stabilized by Honeycomb Cores
– W. W. Troxell and H. C. Engel, Glenn L. Martin Co.

Philosophy of Design in Sandwich-Type Structure
– J. F. Korsberg, Boeing Aircraft Co.

Experiences of an Aircraft Manufacturer with Sandwich Material
– H. B. Gibbons, Chance-Vought Aircraft Div., United Aircraft Corp.

10:00 a. m. **Fuels and Lubricants**

Symposium on Instrumentation

A Photoelectric Dynamometer Load Control
– M. R. Clapp, Lubri-Zol Corp.

Aircraft Detonation Indicators
– J. S. Bogen and W. J. Faust, Universal Oil Products Co.

An Instrument for Piston Temperature Measurement
– A. C. Scholp, G. R. Furman, and P. A. Binda, The Texas Co.

The Development of Detonation Instrumentation for Automotive Vehicles
– J. W. Wheeler and J. H. Goffe, Sperry Gyroscope Co., Inc.

10:00 a. m **Tractor and Farm Machinery**

Crawler Tractor Performance Data with a Hydraulic Torque Converter Incorporated in the Propelling Drive
– A. H. Deimel, Spicer Mfg. Div., Dana Corp.

2:00 p. m. **Aircraft**

Design Features of the North American Navion
– S. C. Hellman and Ed Schmued, North American Aviation, Inc.

Practical Problems in Reducing Noise in Personal Planes:

Engine and Airframe Aspect
– B. J. Simons, Stinson Div., Consolidated Vultee Aircraft Corp.

Propeller Aspect
– L. J. Trigg, Sensenich Brothers

2:00 p. m. **Fuels and Lubricants**

"Frigid-Air" Starting and Operation
– R. W. Goodale, Standard Oil Co. of California

Engine Warm-Up with Present-Day Fuels and Engines
– J. G. Moxey, Jr., Sun Oil Co.

2:00 p. m. **Air Transport**

Engine Trouble Shooting in the Air
– John Lindberg, Pan American Airways, Inc., and Clifford Sackett, Lindberg Instrument Co.

Ignition Analyzers for Internal Combustion Engines
– J. V. McNulty and H. C. Welch, Scintilla Magneto Div., Bendix Aviation Corp.

8:00 p. m. **Production**

Evolution Applied to Industrial Democracy
– G. T. Christopher, President, Packard Motor Car Co.

FRIDAY, JANUARY 10

10:00 a. m. **Diesel Engine**

The Effect of the Nitrogen and Sulfur Content of Fuels on the Rate of Wear in Diesel Engines
– C. C. Moore and W. L. Kent, Union Oil Co. of Calif.
Prepared discussion by J. W. Pennington, Caterpillar Tractor Co., and A. H. Fox, Standard Oil Co. (Ind.)

Minute Amounts of Cylinder Wear Are Measured with a Microscope
– C. S. Bruce and J. T. Duck, National Bureau of Standards
Prepared discussion by C. A. Bierlein, Cleveland Diesel Engine Div., GMC

10:00 a. m. **Air Transport**

Review of Air Transport Development for the Year 1946
– O. E. Kirchner, American Airlines, Inc.

Symposium—Future Developments in Air Transportation

Economics
– H. E. Nourse, United Air Lines, Inc.

Engines
– R. C. Loomis, Trans World Airline

Aircraft Structures
– H. E. Hoben, American Airlines, Inc.

2:00 p. m. **Diesel Engine**

Outline of Navy Program for Future Diesel Fuels; and
Navy Experience with Diesel Fuels During the War
– Captain W. C. Latrobe, Bureau of Ships, Navy Department

Navy Diesel Engine Research – W. F. Joachim, U. S. Naval Engineering Experiment Station

2:00 p. m. **Air Transport**

Recent Developments in Thrust Augmentation as Applied to Radial Engine Installations – W. A. Clegern, Consolidated Vultee Aircraft Corp.

Complete Power Egg Ground Testing – R. W. Lahners, Trans World Airline

CALENDAR

of Section Meetings

Baltimore – Dec. 12

Engineers Club, dinner 7:00 p.m. The Practical Helicopter – S. E. Hamilton, president, and Herbert Hamilton, vice-president, Hamilton Helicopter Co.

British Columbia Group – Dec. 4

Georgia Hotel, Vancouver; dinner 7:00 p.m. Automotive Parts As Used in Industrial Equipment – Lloyd Graves, Canadian Mixermobile Co., Ltd.

Cincinnati – Dec. 9

Alms Hotel; dinner 6:30 p.m. Motion Picture – What Formica Is – R. W. Little.

Cleveland – Dec. 9

Carter Hotel; dinner 6:30 p.m. Application of X-Ray and Electron Diffraction and Electron Microscopy in Automotive Research and Development. - D. M. McCutcheon, Ford Motor Co.

Dayton – Dec. 3 and 10

Dec. 3 – Shawnee Hotel, Springfield; dinner 6:30 p.m. Developments of the Dual-Fuel Engine – H. F. Shepherd, chief research engineer, National Supply Co.

Dec. 10 – Van Cleve Hotel; dinner 6:30 p.m. Ignition Progress – H. L. Hartzell, Delco-Remy Division, General Motors Corporation.

Detroit – Dec. 2 and 16

Dec. 2 – Horace H. Rackham Educational Memorial Building, dinner 6:30 p.m. Flight at Supersonic Speed – Dr. A. Keuthe, professor of aerodynamics, University of Michigan. Transfer Machines – Robots of Production – J. H. Mansfield, chief engineer, Greenlee Bros. & Co. Dinner Speaker: Wilbur Shaw, president, Indianapolis Speedway Association. Subject – Stay Out In Front.

Dec. 16 – Horace H. Rackham Educational Memorial Building, meeting 7:30 p.m. Torque Converters and Their Uses – Lawrence H. Smith, vice-president, General American Aerocoach Co. Exhibits will be shown in connection with this meeting.

Metropolitan – Dec. 19

Pennsylvania Hotel, New York; meeting 7.45 p.m. Possibilities of Diesel Power – C. G. A. Rosen, director of research, Caterpillar Tractor Co.

Mid-Continent – Dec. 6

Ponca City, Oklahoma; dinner 6:30 p.m. Electrical Equipment for Personal Airplanes – John B. Hiday, Delco-Remy Division, General Motors Corp. Speaker - Herb Rawdon, Beech Aircraft Corp. Subject – To be announced.

Milwaukee – Dec. 6

Milwaukee Athletic Club; dinner 6:00 p.m. Modern Motor Fuels – Dr. Gustav Egloff, petroleum technologist, Universal Oil Products Co.

New England – Dec. 3

Engineers Club, Boston; dinner 7:00 p.m. Post-War Fuel Systems – William J. Burns, Carter Carburetor Corp.

Northern California – Dec. 10

Engineers Club, San Francisco; dinner 6:15 p.m. Piston Failure by Pre-Ignition and Detonation – E. P. Viscia and A. G. Cattaneo.

Northwest – Dec. 6

Gowman Hotel, Seattle; dinner 7:00 p.m. Heavy Duty Springs – N. E. Hendrickson, vice-president, chief engineer, Mather Spring Co.

Oregon – Dec. 13

Portland Traction Co.; meeting 7:00 p.m. Visual and practical demonstration with a Clayton-Dynamometer run in engine tests with Thermocouples-Pyrometers, and so on, under direction of a three man panel including C. H. Lewis, Standard Oil Co. of Calif., Earl A. Marks, Earl Marks Electric Service, and Frank Costanzo.

Philadelphia – Dec. 11

Engineers Club; dinner 6:30 p.m. Passenger Cars – Joseph Geschelin, Detroit editor, Chilton Co. Technical Chairman – Adolf Gelpke.

Southern California – Dec. 12 and 27

Dec. 12 – Biltmore Hotel, Los Angeles; meeting 8:00 p.m. Air Transport Meeting. Chairman – R. L. Ellinger. Some Factors Influencing Operating Cost Analysis of Transport Aircraft – Byron B. Masterson, sales engineering and Charles F. Thomas, sales engineering manager, Lockheed Aircraft Corp. Paper to be presented by Charles F. Thomas.

Dec. 27 – San Diego Women's Club, San Diego; meeting 8:00 p.m. Jet Engines – Air Commodore F. J. Whittle, RAF.

Southern New England – Dec. 4

Bond Hotel, Hartford; dinner 6:45 p.m. Supersonic Aerodynamics – Dr. W. F. Hilton, Applied Physics Laboratory, Johns Hopkins University. Silent Motion Picture Film Slides.

Twin City – Dec. 6

Curtis Hotel, Minneapolis; dinner 6:30 p.m. Problems in the Development of the Allison Model V1710 Engine – D. Gerdan, chief engine engineer, Allison Division, General Motors Corp.

Washington – Dec. 10

Twenty-Four Hundred Hotel; dinner 7:00 p.m. Speaker and subject to be announced.

Wichita Section – Dec. 12

Airway Cafe, Inc.; dinner 6:45 p.m. Subject – Transportation. Speaker to be announced. Motion pictures.

Williamsport Group – Dec. 2

Home Dairy, Williamsport; dinner 6:45 p.m. Analysis of Combustion As Shown By Photographs – C. D. Miller, research engineer, National Advisory Committee for Aeronautics.

SHAPE Of Bodies Can Mean More Mpg

Digest of paper

By ALEX TAUB

Matam Corp.

DESIGNERS must treat passenger car bodies as three dimensional shapes rather than a series of lines if more miles are to be squeezed out of each gallon of gasoline, advises Taub. Drawing upon the work of the French designer, Jean Andreau, he relates that:

Wind resistance is responsible for two thirds of the car driving load. Controlling elements of wind resistance are surface and shape.

Import of this concept is conveyed by test data showing that a misplaced license plate can require 4 hp at 60 mph – 1 hp from frontal resistance and 3 hp from drag. If true, this means that a poorly located license plate consumes 2½ lb of gasoline to move it at 60 mph.

Assuming that one third the cars in this country travel at 60 mph or more for about 100 hr per year, this misplaced plate costs 40 million gallons of gasoline per year. If it is felt that this is important only at 60 mph, it should be pointed out that this plate absorbs 1 hp at 30 mph. Three times as many drivers travel at this speed five times as often.

In evaluating miles-per-gallon in terms of horsepower, we can change the terms to reserve horsepower or reduced horsepower. Any reduction in horsepower requirements would increase power reserve for performance or permit use of a smaller engine.

Based on Andreau's approach in design of the 3-wheel Mathis, improvement in fuel economy of American cars due to shape should average 30%.

Key to attainment of this fuel economy is the design philosophy that the car body should be treated as a shape, not lines.

Shapes or position relative to the wind must eliminate lift or suction effect. Air must pass along the body surface with nearly neutral components or resultant pressure effects. Ideal result is when the sum of all equals zero.

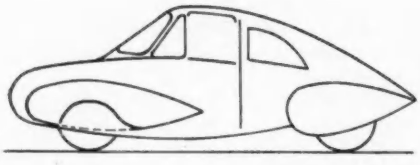


Fig. 1 – Car designed on the theory that the whole should be treated as a shape rather than lines to minimize wind resistance

To provide a shape to which wind screen and roof can be added, we must consider an ellipse with the minor axis equal to the height of the body. It should also be kept in mind that the car does work when it shovels air as if it were snow. It offers surfaces that create drag, lift, or both, depending upon the direction air currents are forced to take relative to the surfaces.

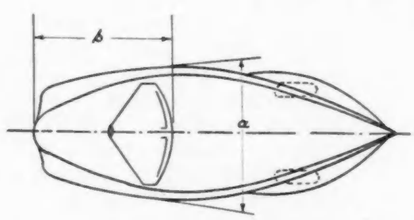


Fig. 2 – Plan view of the car showing how the elliptical pattern is maintained

Air must be entered without speeding up the air above the speed of the car. The valley between fender and hood may collect air, speeding it up to four times the speed of the car. The problem is to enter air with ease on four sides – top, left, right, and, most important of all, the underside.

The air split line, where the air goes over and under the car, must be considered. This area is usually messed up by grille and bumper, the design of which is most undesirable for dividing an airstream and providing reasonable flow in each direction. To excite the least amount of work, it would be ideal to have nearly neutral pressure all over the car.

There is bound to be positive pressure in front. But it can be minimized by providing a shape that uniformly deflects the air, instead of creating eddies that represent work.

Fig. 1 shows a car that reflects the "shape" approach to body design.

The parabolic front end is a burnt offering to the artist. But it does give a uniform curvature. The complete ellipse in front and the unfinished ellipse at the rear is best for entering the air within the allowable length and is the best shape for minimum subpressure. This approaches an air foil or airplane wing, except the tilt is such as to neutralize the lift.

Roof curve is important and should be an ellipse. The windshield angle should approximate 60 deg. Intersection of hood line and windshield should provide the longest curve of uniform change that will be tangent to windshield and hood. Junction of roof and windshield should be parabolic. This may have considerable variation.

Wheels must be enclosed in an air foil to reduce resistance. Checks made show that quite often when fenders are removed, resistance goes down instead of up.

To carry out the general pattern, the front fender should be based on the ellipse. It may be a combination of the complete ellipse in the front and an incomplete ellipse at the rear.

The rear fender is more complicated. Plan view characteristics, shown in Fig. 2, are more important than the simple lines of the air foil.

Plan view of the car is a basic ellipse with 2a as major axis and b as minor axis. For the rear end we again have the unfinished ellipse of a radius equal to the maximum radius of the ellipse.

Rear fenders are complex. Normally the surface and outline ignore the fact that air flow is following the shape of the body. If there is to be minimum drag from the fenders, then they must follow the direction of the wind.

Perhaps no amount of fuel saving will inspire designers to consider shape rather than lines. But probably performance combined with increased mpg plus the inevitable increase in fuel tax and the return of a buyer's market may arrest attention. (Paper entitled "The Relationship of Lines Versus Shape on Miles per Gallon," presented at the SAE Summer Meeting, June 3, 1946.)

Engine Worries Wane With All-Purpose Oils

Digest of paper

By E. B. LIEN

Union Oil Co. of Calif.

ADDITIVES in heavy-duty oils have lessened motor vehicle operators' woes by successfully combating engine troubles, says Mr. Lien. He traces development of heavy-duty all-purpose lubricants to show that:

Susceptibility of both diesel and gasoline engines to sludge formation and bearing corrosion were countered by oil additives for detergency, dispersency, and oxidation.

Trend toward greater engine severity

promoted thickening of lubricant and catalysis from metal contamination. Temperatures increased and efficiencies decreased. Symptoms of these ills were well-known difficulties of ring sticking, gumming, and sludge formation.

Products compounded with low-viscosity index naphthenic oils appeared as the solution. They exhibit greater solvent action for sludges, soot, and fuel composition products than paraffinic oils previously used. This class of oils permits longer operation before sludging starts.

New Alloys Court Corrosion

Bearing corrosion did not become a problem until babbitt bearings were replaced by cadmium-silver and copper-lead. Additive oils in use at that time developed acidic materials that proved corrosive to these alloys. Soap additives acted as an oxidation catalyst to accelerate acid formation.

Several solutions to these difficulties were found. In one method oxidation inhibitors were used. A second method of arresting corrosion was by the use of alkaline reserve type additives. Although neutral in themselves, these additives reacted with acids developed in service to produce noncorrosive products.

Metal deactivator type additives used also resisted corrosion. One type, a phosphorous-sulfur compound, was absorbed by the bearing to form a protective surface. In another case the bearing was coated with a thin film of copper sulphide by using an additive containing active sulfur.

Mating Fuel and Oil

An unexpected trouble encountered with all-purpose oils was the difficulty in cutting carbon on aluminum piston crowns. Deposits of carbonaceous material built up on the unswept area of the piston, beyond the point of normal clearance between crown and liner. Eventually it was found that the primary cause for this was the type of fuel used with the oil. Where carbon cutting is a problem, use of a low-octane value, high end point fuel with a high-viscosity index all-purpose lubricant is recommended.

Operators should be cautioned about using these heavy-duty oils as cleaning and purging lubricants. These oils were developed to maintain a clean engine in a clean condition and not to clean up a badly fouled engine. Loosening of soft, pasty deposits in fouled engines can plug oil pump intakes and disrupt oil circulation if not noticed immediately. (Paper "Heavy-Duty Motor Oils and Suggested Engine Design Changes," presented at SAE Hawaii Section, Aug. 19, 1946.)

Fuel Nonvolatiles Promote Deposits

Digest of paper

By W. J. SWEENEY, J. F. KUNC, JR., and W. E. MORRIS

Standard Oil Development Co.

EXCESSIVE deposits in aircraft fuel induction systems that lower engine performance have been traced to nonvolatile fuel constituents, Messrs. Sweeney, Kunc, and Morris disclose. They report that:

Accumulation of deposits in the fuel induction system diminishes the size of passageways and reduces airflow to the engine at a given throttle opening. If the engine is operating at or near full throttle decreased air flow will reduce power output.

In engines with gear-driven superchargers, deposits building up on the diffuser plate and impeller may gradually force the impeller forward. Overloading the impeller space in this fashion leads to ultimate mechanical failure of the supercharger.

Shown in Fig. 1 is a supercharger after 639 hr of service, removed from an engine experiencing such difficulties. Although not readily apparent, the deposits were black in color and quite brittle.

Reasons for induction system deposition based on field experience and experimental tests are as follows:

1. Any increase in nonvolatile viscous, resinous, or solid constituents in the fuel is favorable to deposits. It should be avoided. Such nonvolatile constituents might be gum, inhibitors or their degradation products, and components such as dye and nonvolatile impurities. The chart above demonstrates how deposits build up with increases in gum and Ethyl fluid.

2. Various types of inhibitors used to stabilize fuels against deterioration in storage differ radically in deposit-forming tendencies. Oxidized or degraded inhibitors are particularly bad.

3. For a given engine and fuel, there seems to be an induction system temperature that will give maximum deposit formation. Or conversely, for a given temperature there appears to be a fuel volatility that gives maximum deposition. Deposit formation is apparently greatest with relatively volatile fuels at high operating temperatures.

Although a fuel meets all existing specifications, it can impair engine performance if it contains more than enough nonvolatile material and if conditions conducive to deposits prevail.

This is corroborated by data obtained under such circumstances. In this case roughly 31,000 gal of fuel passed through a typical engine after 750 hr of airline operation – the normal period between overhauls. Total weight of gum, dye, and inhibitor passing through the engine was 12 lb; less than 1 lb can lead to operational difficulties. (Paper entitled "Aircraft Engine Induction System Deposits," presented at the SAE Annual Meeting, Jan. 9, 1946.)

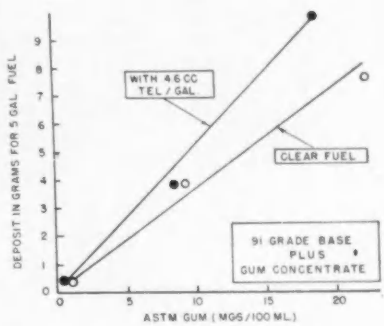


Fig. 2 – Fuel deposits in the induction system vary proportionately with the amount of gum and Ethyl fluid added

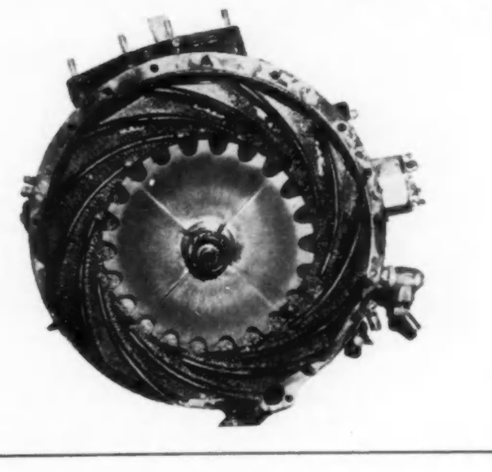
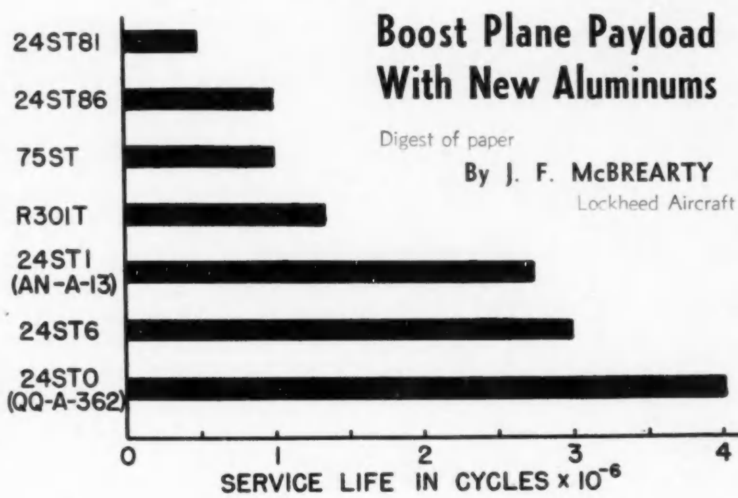


Fig. 1 – Deposits on this gear-driven supercharger that has been in service 639 hr eventually can lead to mechanical failure by forcing the impeller forward. The material deposited is black and brittle

Boost Plane Payload With New Aluminums

Digest of paper

By J. F. McBREARTY
Lockheed Aircraft Corp.



BY REDUCING airplane weight, high-strength aluminums increase payload on long-range flights by 10 to 20%, says McBrearty. He reports that:

These new materials have improved strength characteristics. They are yielding still greater physical properties as engineering and manufacturing "know-how" progresses.

Development of alloys 14S, 75S, R301, and R303 represented quite a gain for the designer. Elevated temperature aging imparts to them very high yield strengths and relatively high elongations. These properties are not affected by cold working prior to aging.

Through artificial aging and new alloys, yield strength has been increased as much as 40%. When conditions permit changes in previous forming and heat treating, available yield strength has been increased about 75%. This is apparent by comparing 24ST at 37,000 psi with 75ST at around 65,000 psi.

Since proportions, size, and weight of the airplane are determined by a compromise of compression member bulk and the extent of its support, increased permissible yield strength raises the designer's horizon.

Modulus of elasticity is important as it is a measure of the material's resistance to most types of instability failure. This property determines the amount of maximum stress that can be obtained from a compression member with a given amount of support. For this the slope of the stress-strain curve, shown in Fig. 1 for several materials, is widely used. Extruded 75ST is shown to be superior throughout the stress range and 24ST86 exhibits the highest modulus for sheet materials except at very highest stresses.

Fatigue strength is receiving more attention in the fields of external loads, dynamic, and detail designs. Usual scatter of test data precludes very precise comparisons; but a general trend shows aging does not improve fatigue strength and may even reduce it.

The chart above illustrates the significance of fatigue strength wherever this type of failure is an important design consideration. In this case the service life of the lap joint at 200 lb per rivet varies by a factor of about 8 in the extreme and by about 3 as an average between aged and unaged tempers.

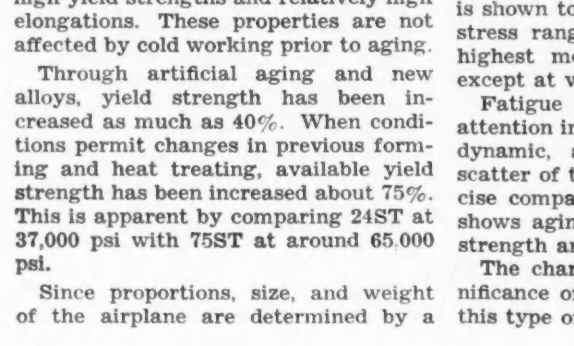


Fig. 1 – Slope of these stress-strain curves indicates the modulus of elasticity of each material, a measure of the material's resistance to instability failures

Optimum material for each structural part can be obtained by selecting high-strength aluminums in accordance with the following conclusions drawn from tests and experience:

1. Extrusions should be 75ST. If the aging cycle is too long, 24ST8 extrusions should be used;

2. Sheet metal parts requiring forming in the annealed state should be 75S or R303. If shorter aging time is necessary, 24ST80 should be used;

3. Sheet metal stringers and stiffeners should be 24ST86 if their shape is such that forming can be done in the "SRT" state;

4. Thin skin panels should be 75ST if dimpling techniques are available, otherwise they should be 24ST81;

5. If dimpling can be performed before aging, thin skin panels should be 24ST86 as should thicker skins than can be countersunk.

Judicious choice of high-strength aluminum alloys paid dividends in the design of one Lockheed plane. In the wing alone 920 lb were saved. Total saving for the entire airplane is estimated to be over 2000 lb. (Paper "Utilization of New High Strength Aluminum Alloys," presented at SAE Southern California Section, Oct. 4, 1945.)

Ground Speed-Up Urged For Expanding Air Travel

Based on Papers by J. D. Hungerford[1], J. W. Colthar[1] and S. J. Solomon[2]

ONLY limitation to the growth of air transportation is the ability of the airlines to handle greatly increased business, agree Messrs. Hungerford, Colthar, and Solomon. In an analysis of ground operations that must be simplified to absorb expeditiously the expected air travel demand, they show:

Business is definitely mushrooming and will continue to do so for a good many years. In Table I, listing revenue passenger-miles flown by the air transport industry since 1930, Messrs. Hungerford and Colthar show that the volume in 1950 will more than treble anticipated business this year. (Figures for 1930 to 1938 include nonrevenue passenger-miles and those for 1946 and 1950 are estimates.)

But prospects of handling this great increase are not too good – if present methods are continued, says Mr. Solomon. An example of present inefficiency was brought to light in uncontested testimony given at the Middle Atlantic Case hearing conducted by the Civil Aeronautics Board. It revealed that travel time from Washington to New York – city center to city center – was less in 1932 than it is today!

This apparent lack of progress is the result of delays in more complicated ways of handling passengers and in loading and unloading that more than offset technical developments of the airplane, he continues.

Public demand for convenience, frequency, and volume must be met. If the airplane does not take John Q. Public to his destination much quicker than does a train or bus – and this is

almost the case in some instances – then the airlines nullify their big selling point.

Since ground handling is the greatest time parasite, radical changes must be made to step up this phase of the operation.

To begin with, traffic statistics should be studied to evolve a pattern of public demand for transportation by hours of the day, days of the week, and seasons of the year as well as by destination. It is both Mr. Hungerford's and Mr. Colthar's experience that only by such an analysis can a workable schedule be developed.

Mr. Solomon adds the following recommendations:

Reservation systems must be simplified. All airlines using a common terminal must provide flight dispatch information uniformly. By the same token, air transportation has outgrown the period of reluctance to divulge reasons for flight delays. A full and frank disclosure as to when an airplane will be delayed in its departure or arrival should be prominently displayed in terminal buildings.

This procedure will eliminate holding up take-off to locate a passenger who tired of waiting and temporarily disappeared. With frequent departures to almost every airline point, a passenger or piece of air express temporarily unlocated could be dispatched on the next flight rather than hold up those already in the airplane.

Ticketing must be simplified and there should be only one passenger check-in. The flight manager accompanying the bus can both ticket and check in the passenger, advising him as to boarding the plane with his baggage in his own custody.

Present luxury of highly personalized service, so courteously extended over the years, has been the greatest single factor in development of air transportation; but it is no longer adapted to mass movement of passengers.

Table 1 – Revenue Passenger-Miles Flown by the Air Transport Industry Since 1930

Calendar Year	Passenger Miles Flown	Calendar Year	Passenger Miles Flown
1930	19,732,677	1939	78,198,601
1931	14,680,492	1940	111,248,022
1932	21,147,539	1941	179,014,271
1933	26,283,915	1942	263,996,932
1934	38,792,228	1943	1,618,929,223
1935	49,495,412	1944	2,238,574,907
1936	45,078,596	1945	3,477,938,308
1937	58,255,437	1946	6,000,000,000
1938	60,110,655	1950	19,800,000,000

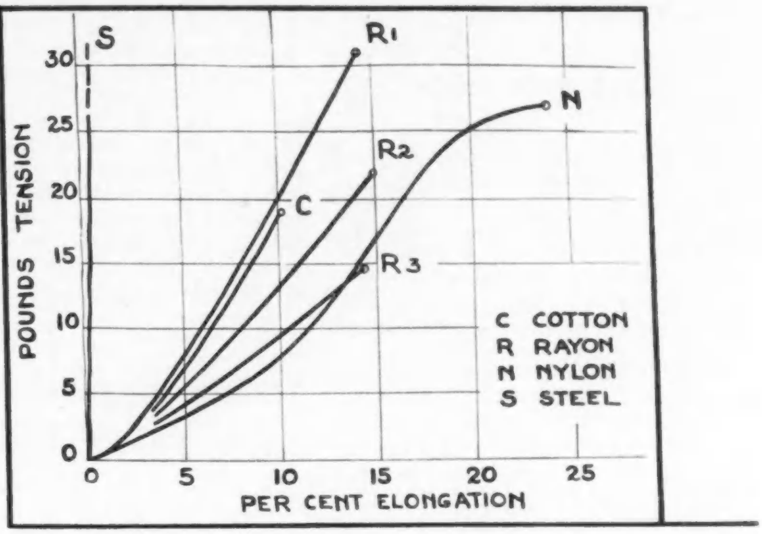
Airplanes themselves must reflect plans for mass passenger movement at minimum expense and effort. They should have self-contained steps – and doors should be located fairly close to the ground. Several full-size entrances and exits will not only facilitate normal ground traffic but will also be handy in emergencies.

With more planes coming into service, the consequent space needed for maneuvering might make for extended walks to departing planes. Reversible-pitch propellers will facilitate handling of the airplane and reduce space requirements in the taxiing area. This will enable the airplane to run into a dock where passengers have ready ingress and egress.

If air service promising breakfast in New York and lunch in Los Angeles is to become a reality, airline operators must accelerate the ground routine. (Hungerford and Colthar paper "Airline Scheduling" was presented at the SAE Aeronautic Meeting (Spring), April 4, 1946; the Solomon paper "Simplifying Terminal Problems" was presented at SAE Summer Meeting, June 6, 1946.)

[1] American Airlines, Inc.
[2] Atlantic Airlines, Inc.

Cord Material Paces Plane Tire Progress



Digest of paper By R. D. EVANS

Goodyear Tire & Rubber Co.

BIG story in aircraft tire development during the past decade lies in the advent of rayon, nylon, and now steel as cord material, reports Evans. In highlighting relative merits of present-day cords, he points out that:

Rayon found its way into airplane tires because of two desirable properties: (1) it has better bruise-resistance than cotton and (2) its higher unit strength permits a substantial over-all weight reduction.

Advantages of nylon cord in military aeronautics apply equally to commercial transports. With this man-made filament we can expect that exceptional unit strength, resiliency, and fatigue strength will be further developed into an outstanding structural component of airplane tires.

Considerable research has been conducted on use of small cables of twisted high tensile steel wire (0.005 to 0.006 in. in diameter) as the tire ply material. Such cables obviously have high strength in proportion to diameter. Very thin-walled tire structures are possible with definite savings in required weight of rubber compound.

How these materials compare in the stress-strain relationship is shown in the graph above. But these characteristics can be more fully appreciated when related to diameter and unit weight values, given in Table I.

Tire development to date points to definite trends. It reveals that weight saving of rubber promised by steel is more than offset by its high gravity.

Table I – Comparison of Cord Material Properties

	Cotton	Rayon	Nylon	Steel
Tensile	19	30	27	195
Diameter	0.032	0.032	0.019	0.036
Relative Weight	100	117	42	600
Modulus	1.4	1.8	1.1	97.5
Tensile/Weight	0.19	0.26	0.64	0.33
Tensile/Modulus	14	17	25	2

Steel-cord tires weigh 25 to 30% more than corresponding rayon tires. Per-

formance, as judged by standard laboratory tests in which the tire is landed against a rapidly rotating wheel, is inferior to rayon. Also the cost of steel wire is prohibitive.

It is reasonable to conclude that for the next few years airplane tires will continue to be built with nonmetallic filament material. (Paper entitled "Pneumatic Tires for Modern Airplanes," presented at SAE National Aeronautic Meeting, April 3, 1946.)

Trained Men Ease Fleet Maintenance

Digest of paper

By E. B. RICHARDSON

Portland Traction Co.

PROPERLY trained men plus simple operations is the formula for successful vehicle maintenance, says Mr. Richardson. To run a shop efficiently, he advises that:

Most important to the maintenance supervisor is the training of men. Mechanic as well as driver should know his job.

In one shop several obsolete street cars are used as mechanics' classrooms. The rigorous 36-day course of study given each new man is divided into 4 hr of instruction and 4 hr practical shop work each day. Also included is an indoctrination on shop policy and the service the shop renders.

Poor drivers can cost the company many maintenance dollars. Even old drivers do not have simple mechanical knowledge on how to operate properly a bus or truck. Often they are guilty of only partially depressing the clutch pedal when shifting, and scraping the gears. Driver instruction courses should be instituted by even one-vehicle companies using slides, movies, and printed matter available. Regular instructors should first work in the shop, learning from experience the innards of a vehicle.

Once the men have been trained, operations should be simplified and systematized.

Open to improvement is the elaborate inspection form used by some shops that require hours for the mechanic to fill out. This can be streamlined by providing each inspection station with a framed list of operations. The mechanic simply signs his clock number to a slip listing buses inspected, keeping records complete and eliminating double bookkeeping by the mechanic.

Another time saver is line inspection. Through proper timing, each vehicle passes from the grease pit to chassis inspection, engine inspection, wash rack, and storage. Each inspector works separately, curtailing socializing. Time of an entire crew is not lost as where all the men work on one bus at the same time, waiting until vehicles are moved on or off the inspection pit.

Repair and servicing operations should follow the same pattern.

Repair jobs sent to outside machine shops often can be done more quickly and cheaply in the maintenance shop if the volume warrants it. This was true in one case where worn shafts are metal-sprayed and reground. Despite the $10,500 investment for the crankshaft regrinder, doing the job in the shop saved over $1500 per year and a lot of time.

What the industry really needs is a rolling field laboratory composed of a group of field engineers equipped with trucks and testing instruments. By checking and analyzing maintenance and suggesting improvements to transportation companies throughout the country, such a group would apprize industry of up-to-date practice. Information gathered on recommended design changes would provide a sounding board for manufacturers. (Paper entitled "Post War Maintenance," presented at SAE Northwest Section, Sept. 15, 1945.)

Wartime Headaches Aid Commercial Air Transport

Digest of paper

By LT.-COL. DAVID W. LONG

Air Transport Command

COMMERCIAL air transport problems are no different from those met and conquered by the military: more weight must be carried than ever before, and carried more efficiently; loading and unloading must be simplified and speeded up. Extensive changes in equipment are necessary, however, before air transport can hope to compete on a cost basis with slower forms of transportation.

Prime necessities, in Long's opinion, are:

1. High wing design. This makes doors more accessible, speeds up loading, and enables use of simpler cargo-handling machinery.

2. At least two adequate loading doors, one at each end of the cargo compartment. These should be at least 6x8 ft.

3. Substantial floors with skid strips and tiedown fittings stressed to a 1000-lb vertical pull, and placed on a standard 24-in. grid. Half-inch thick aircraft plywood with skid strips bonded to it makes a rigid, highly-stressed surface for bearing loads. Dural extrusions above the skid strips absorb wear of skidding cargo. Tiedown rings on a standard grid make possible in-advance stowage assignments.

4. A clear cargo compartment center on the c.g. to simplify weight and balance problems.

5. Elimination of superfluous lumber packing. During the war the ATC established repacking centers at all ports of aerial embarkation, left behind millions of pounds of lumber. Projects currently under way to study packaging requirements will help commercial air transport more nearly to approximate costs of other transportation media.

6. Ability to utilize fully the cargo-carrying capacity built into modern planes – that is, relaxing of limits on gross take-off weight.

7. Uniformity of operations and equipment throughout the world.

These improvements will eliminate the principal deficiencies pointed up by wartime exigencies. Corrections were made quickly and of necessity when wartime carriers were given items "only slightly larger and heavier than the airplane itself" to carry, and almost no machinery and skilled labor to handle them. The task was accomplished by radical revisions of existing planes. Years of research and experience were necessarily crammed into months . . . and the industry will reap the benefits. (Paper entitled "Air Transport Command Cargo Loading Experience," presented at SAE National Air Transport Meeting, Dec. 4, 1945.)

Repair Prevention Cuts Fleet Costs

Digest of paper

By V. E. WEISS

Standard Oil Co. of Calif.

KEY to profitable fleet operation is preventive maintenance, says Weiss. Keeping the vehicle trim and in tune improves fuel and oil economy and keeps repairs and overhauls to a minimum. It is his experience that:

Among the items to be included in a good preventive maintenance program should be:

1. Engines,
2. Bearings,
3. Transmissions and differentials,
4. General chassis lubrication.

Comparison of monthly fuel and oil mileage records will warn the shop supervisor when engine performance is falling off. Analysis of used crankcase oil by specialized companies is a valuable service. It can point to poor combustion, poor cooling, ineffective oil filtering, bearing corrosion as well as forecast failures.

By saving road test costs alone chassis dynamometers will pay for them-

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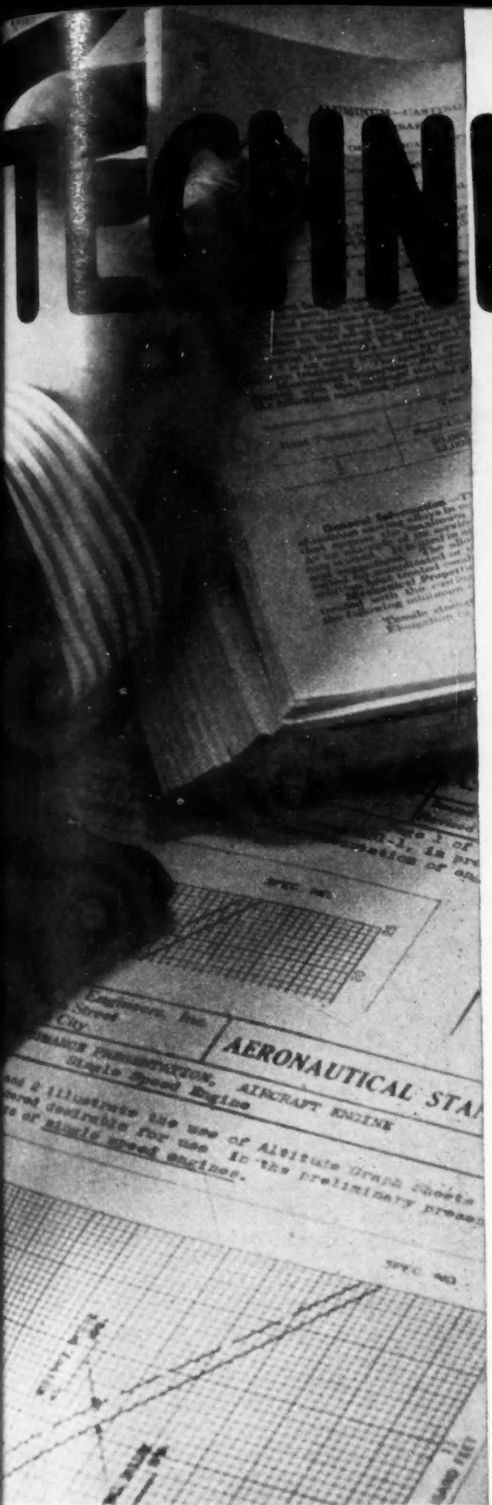

TECHNICAL COMMITTEE PROGRESS

Plan SAE Formula To Better Investment In Trucks and Buses

Helping the fleet operator pick the right truck or bus for the job by means of a standardized transportation formula is the aim of a new committee, set up by the SAE T&M Technical Committee. Its name: the Classification and Evaluation of Transportation Engineering Formulas Committee.

The Committee hopes to develop a formula that will tell a truck operator what type of vehicle he should buy for optimum efficiency under a particular set of operating conditions.

To use the formula, he must know specifically what the operation will require of a truck . . . how much weight must be carried . . . how fast . . . up what grades . . . over what kind of roads. By inserting that kind of data into the proposed formula, he would get the answers as to the horsepower, tire size, gear ratio, and other characteristics the truck he bought for the job ought to have.

Many such formulas are already in use. They were developed by individual manufacturers and operators with variations on this main theme. But validity of the existing formulas has long been questionable. A study of them made by M. C. Horine, Mack Mfg. Co., revealed that each gives a different answer.

Obviously all the different formulas cannot be correct. Basic trouble is that each company's formula varies, depending upon empirical values used. Inserting "experience" factors based on sound judgment of many organizations points the way to a truer formula.

In this project will be involved men prominent in the development of the original formulas as well as other outstanding engineers from vehicle manufacturing and transportation fields. With this kind of membership, the Committee hopes to evolve a formula that both users and manufacturers will agree upon.

Like the old SAE Motor Vehicle Rating Committee that completed its work in 1939, the new

SAE TECHNICAL BOARD

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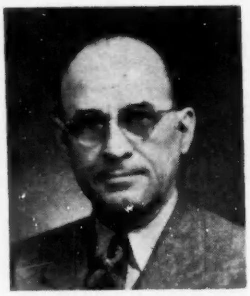


F. B. Lautzenhiser
Chairman

Committee decided that its formula will stem from horsepower requirements.

Other items bearing on the problem that have been assigned for investigation include: acceleration, altitude effect, deceleration, drawbar pull, grade ability, grade resistance, inertia of rotating parts, mechanical efficiency, piston displacement, road and rolling resistance, road speed, torque, tractive effort, and air resistance.

Preliminary surveys indicate that presently accepted values for air resistance, rolling resistance, and gear efficiencies are in need of verification and probably revision. For example, the rolling resistance factor is constant for all speeds in most formulas. But there is evidence that this "constant" is not at all constant with variation in speed.

Initial study has been assigned to three groups to deal with (1) the formula itself, (2) tractive effort, and (3) tractive resistance. At such time that a tentative formula is developed, tests will be performed to check validity of calculated results with on-the-road performance.

An effort will be made to keep the formula as simple as possible for use by nontechnical people in the industry without sacrificing accuracy. It is hoped to publish the formula as an SAE standard or recommended practice in the SAE Handbook. Each value used will be identified and its derivation given.

According to Chairman F. B. Lautzenhiser, International Harvester Co. transportation inefficiencies on highways today are much higher than many would care to believe. The examples are many.

There are tractor and semi-trailer combinations in use where a four or six-wheel straight truck would do, and vice versa; equipment is overloaded because it is underpowered or under capacity; gear reductions are incorrect or insufficient; load distribution is incorrect, and the fifth wheel is improperly located.

And in some cases the truck on the job is actually unsafe. One bad accident can cost more than a fleet of good safe trucks.

Industry feeling is strong that some reliable tool should be made available to rectify these errors in judgment and to avoid their repetition in the future. The Committee hopes to provide industry with such a formula.

Serving with Chairman Lautzenhiser on the Committee are: E. P. Gohn, Atlantic Refining Co.; E. N. Hatch, New York Transit System; G. T. Hook, Commercial Car Journal; M. C. Horine, Mack Mfg. Co.; H. L. Willett, Jr., Willett Co.; V. G. Kloepper, Ford Motor Co.; E. P. Lamb, Dodge Truck Division, Chrysler Corp.; M. E. Nuttila, Cities Service Oil Co.; W. C. Parker, Diamond T Motor Car Co.; S. Colacuori, International Harvester Co.; C. Saal, Public Roads Administration; H. Stevens, American Trucking Associations; W. A. Taussig, Burlington Transportation Co.; W. E. Turner, GMC Truck & Coach Division; T. Baldwin, Jr., Kraft Cheese Co.; R. Cass, White Motor Co.; F. R. Faulkner, Armour and Co.; F. K. Glynn, American Telephone and Telegraph Co.; H. L. Rittenhouse, Euclid Road Machinery Co.; A. M. Wolf, consulting engineer, and R. B. Wuerfel, GMC Chevrolet Motor Division.

Hydraulic Standards Cut Plane Weight

REFLECTED in recent SAE aircraft hydraulic and pneumatic equipment standardization is both industry's and Government's drive toward reduced plane weight and greater safety.

Typical of SAE Committee A-6 projects aimed at greater payload and

B. R. Teree
Chairman

accident prevention are the following three:

1. Standardization of 3000-psi hydraulic system equipment;
2. Development of an inflammable hydraulic fluid;
3. Development of pneumatic system specifications.

General trend in new aircraft production has been toward the 3000-psi hydraulic system, replacing the 1500-psi system. Principal reason for doubling the pressure is the reduced weight of hydraulic lines and fittings.

One problem associated with high-pressure systems being tackled by the Committee is the development of satisfactory procedures for testing the fittings. This effort is being coordinated with both industry and Government to arrive at a set of test requirements agreeable to both groups.

In line with the fitting test program the Air Materiel Command at Wright Field has developed a testing machine. With this machine it is hoped to aid development of improved fittings. Four different types of fittings already have been submitted to the AMC for testing.

Another phase of high-pressure hydraulic systems in which bugs must be eliminated is tubing. A satisfactory high-strength light-weight material being used for this purpose is 24ST seamless aluminum alloy tubing specified in AMS 4086. Some manufacturers have experienced difficulty in bending and flaring this tubing. Surface condition of the tubing has been found to be a dominant factor in cold working failures.

At a recent AMS meeting tubing manufacturers agreed to a revision now being incorporated in the specification. It requires that the tubing be free of visible external and internal defects; it should show no cracks, laminations, or folds in etched cross-section magnified 100 diameters.

Elimination of these imperfections is considered a major improvement in resistance to failure from repeated pressure impulses. Smoother surfaces also should eliminate tube shaping troubles.

Development of an inflammable hydraulic fluid, reports Chairman B. R. Teree, The Weatherhead Co., has been undertaken by the industry at request of the CAA. The CAA feels that a less flammable fluid to replace present standard hydraulic fluid is desirable in eliminating a potential fire hazard in civil aircraft.

Several inflammable fluids have been tested but none fill the bill. Committee action toward development of a satisfactory material was initiated by Chairman Teree. He appointed a subcommittee under F. W. Murphy, Douglas Aircraft Co., Inc., to develop a set of requirements for an inflammable fluid that can serve as a basis for complying with CAA regulations.

The third project, development of pneumatic system specifications, is still in its exploratory stages. Advantages of using air instead of hydraulic fluid as the energy-transmitting medium are the savings in weight and cost of the fluid. Also the fire hazard claimed for hydraulic fluids would be nonexistent.

Work of the Committee is first to investigate requirements for such a system and its individual items of equipment. Initial efforts to replace hydraulic with pneumatic have been in individual controls only such as those for bomb bay doors.

An interesting report on the progress made by his company in this new field was presented at the last Committee meeting by J. M. Kidd, Glenn L. Martin Co. He disclosed that Martin specifications have been written for a pneu-

matic system covering the controls of bomb bay doors, camera doors, and brakes. Air for the system is supplied by two engine-driven compressors to storage bottles at from 1200 to 1500 psi. Air pressure is reduced to from 150 to 500 psi for actual operation.

Capacity of main storage bottles is sufficient to provide three complete openings and closings of bomb bay and camera doors. An emergency system will open and close these doors once and also operate the brakes.

Compressors are fed either by air at atmospheric pressure or from the jet engines. Weight of the system is about 180 lb excluding plumbing.

Next Committee meeting will be held at a location easily accessible to guests from the military services.

SAE Checks Menace Of Runaway Trailers

TRAILER tendency to runaway and jeopardize both fleet equipment and highway traffic will be minimized if SAE recommendations to the Interstate Commerce Commission on safety chains for truck-trailer couplings are followed.

Development of safety chain specifications was undertaken by the Safety Chain Subcommittee of the SAE Motorcoach and Motor Truck Committee at the ICC's request for assistance in revision of existing legislation. The Committee makes three recommendations in its recently completed report:

1. Emergency brakes are most effective in controlling a runaway trailer. A safety chain should be installed to prevent the trailer from breaking loose in case the drawbar eye or coupling fails;

2. Type and size of chain in keeping with gross vehicle weight and drawbar pull are shown in Table I;

3. Optional methods of attachment, as shown in Fig. 1, should be permitted. Points of attachment must fully develop the capacity of the chain and serve as an emergency extension of the drawbar, keeping the trailer closely attached and in alignment with the towing vehicle.

Crux of the problem in coupling or drawbar failures, says the report, is to keep the trailer under control, operable, and aligned with the towing vehicle.

Most effective means of control is an emergency brake that locks automatically in case of a break in the coupling. The brake, together with a safety chain that prevents the drawbar from striking the ground and keeps the trailer closely coupled, is the ideal arrangement.

The trouble with installations permitted by many present state laws is that they accomplish none of these functions. In a breakaway, control of the runaway trailer is out of hand until slack in the chain is taken up. At that point, the sudden impact either snaps the chain or pulls it loose from its attaching points. Many cases are known where a trailer without a breakaway brake broke loose and ran wild into oncoming traffic or into a ditch.

With lower speeds and weights prevalent at the time existing laws were enacted, safety chains were helpful in controlling runaway trailers. But in operating at 35 to 50 mph today, safety chains in themselves fail to function as a safety precaution – especially since emergency brakes on the runaway impose even heavier loads on the chains.

Strength of Mounting Important

Another important point, says the report, is the method of attachment to both full trailer and towing vehicle. Standard practice is to install a ¾ or 1-in. eye bolt in the web of a convenient cross-member. This mounting does not develop the capacity of present chains, let alone the capacity of larger sizes required to hold the trailer in a breakaway.

An emergency brake, opines the Committee, as required by some states for

Table I – Safety Chain Specifications

	Gross Weight up to 5,000 lb	Gross Weight Between 5,000 and 24,000 lb	Gross Weight Between 24,000 and 50,000 lb	Gross Weight Over 50,000 lb
Size and Type of Chain	$^3/_{16}$-in. Proof Coil	⅜ BBB	½ BBB	¾ BBB
Number of Chains per Trailer	1	1	1	1
Ultimate Capacity of Each Chain	2,000 lb	9,300 lb	16,500 lb	35,400 lb

full trailers, should be specified for less-than-3000-lb trailers too. In this group are house trailers and lightweight units usually towed by means of a hitch mounted on a passenger car rear bumper.

In conclusion, the report urges the replacement of inconsistent and outmoded state laws with uniform legal requirements in line with modern vehicle construction practice.

Membership of the Safety Chain Subcommittee is as follows: A. E. Williams, Fruehauf Trailer Co., Inc., Chairman; J. J. Black, Trailmobile Co.; G. L. Knox, Utility Trailer Mfg. Co.; F. M. Smith, Palace Coach Co.; J. Stephen, Highway Trailer Co., and J. T. Weber, Weber Trailer & Mfg. Co.

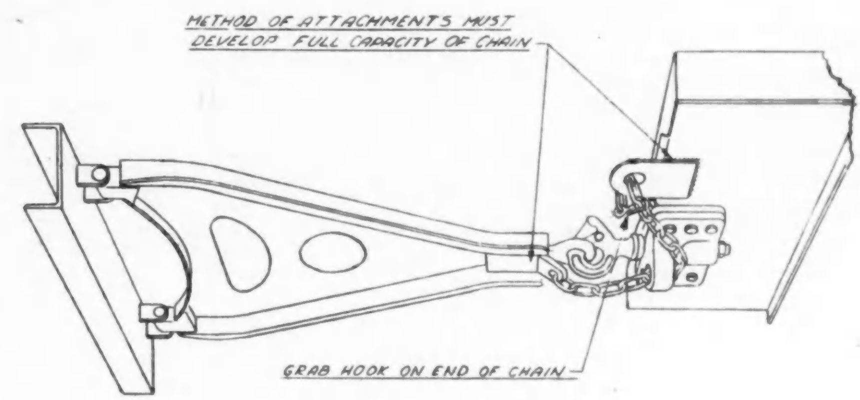


Fig. 1—Both of these methods of attaching a truck-trailer coupling safety chain were recommended by the SAE Safety Chain Subcommittee to the Interstate Commerce Commission

Buyer Reluctance Retards Switch to H-Band Steels

THE hardenability-band specification method of purchase has not worked its way into steel buying practice with expected rapidity. Slowness of some users in adopting this method seems to stem from their belief that bands based on hardenability are too wide.

They continue to specify chemistry only, using the old composition limits that allow use of heats having lower hardenability than permitted by the new bands. This has been demonstrated by metallurgists of the SAE Iron and Steel Technical Committee and the AISI Alloy Technical Committee.

Discussions at recent meetings of the SAE Committee disclosed that:

Another reason for users' reluctance to use H-band steels has been doubt as to the need for the top side of the bands. Steel buyers appear not much concerned about cracking when hardenability approaches the top side of the H-band specifications. For that reason, most user specifications that include hardenability requirements stipulate only to minimum hardenability and chemical composition. However, buyers have been asking for minimum hardenabilities near to the top sides of the bands and using conventional chemistry limits.

This is doubly restrictive on the steel producer. It forces him to work with two systems and tends to increase the rejection rate of heats. By such hybrid hardenability and chemistry specification, the user does not gain the full advantage of H-band steels.

Metallurgists of the SAE and AISI groups – who jointly issued tentative H-bands for 60 steels and now have an additional 27 bands ready – say steel users are missing a good thing. This is supported by a large quantity of test data that these groups have accumulated. They speak from wide experience with H-band steels in production – especially NE steels during the war.

They know that hardenability bands based on chemistry requirements only for prewar steels, when laid alongside H-bands for postwar steels, show definite advantages to the user from the latter. Data show that H-band spreads are actually much closer than hardenability spreads resulting from chemistry specifications – something like 70 to 80% of the chemistry spread.

This contention is well illustrated by Fig. 1. Solid lines represent the tentative hardenability bands for SAE 8630 steel and the dotted lines are hardenability bands of 126 heats of the same steel purchased to conventional chemistry specifications. It is obvious that the user is assured the steel he buys will vary over narrower ranges of hardenability when he specifies by the H-band method.

For example, at the 6/16-in. point on the Jominy bar, as demonstrated by Fig. 1, the spread on the H-band for 8630 steel is from points A to B, or J-33 to J-48. On the same steel purchased to standard chemistry, the spread is from A' to B', or from J-26 to J-56. In other words, the buyer takes less of a

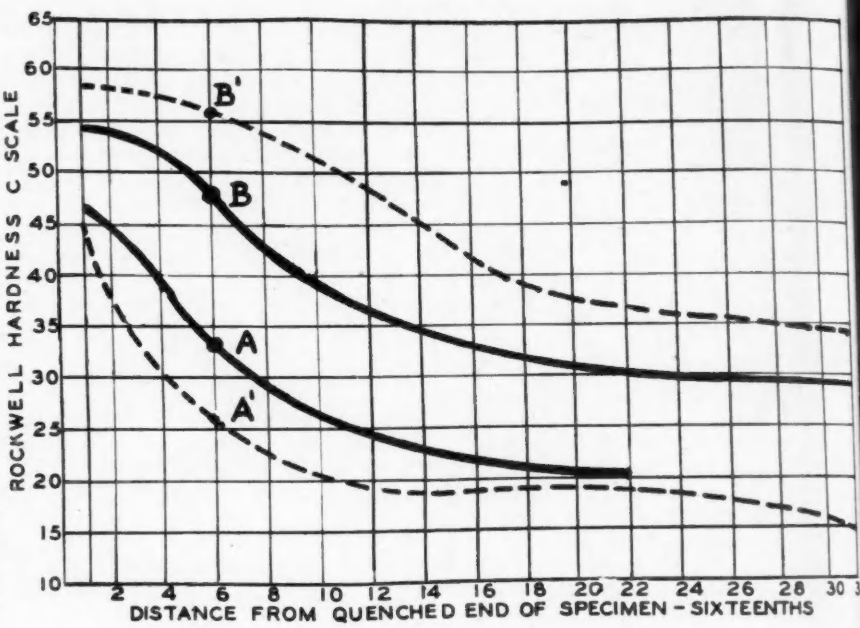


Fig. 1—Examination of SAE 8630 steel hardenability data reveals the H-band spread (solid lines) is much closer than the hardenability band spread resulting from chemistry specifications (dotted lines)

"gamble" on H-band steels. This relationship exists, to a greater or lesser degree, for all other steels for which H-bands have been prepared.

What it means to the buyer is that he can more readily standardize on heat-treat processes and equipment. His heat-treat set-up need no longer be geared to handle as many variations in hardening and tempering to arrive at the desired uniform characteristics for the finished product. Reprocessing and rejections are reduced.

All this represents substantial savings in time, labor, and material.

It all boils down to the fact that the user will be getting steel that will exhibit – when heat-treated by a uniform process – properties much closer to those required for the end product.

Slowness in approval of the H-band specification method is attributed partly to inadequate selling of its advantages. For this purpose, reports from users are needed showing benefits already accrued from using H-band steels. These reports should be based on characteristics exhibited during heat-treatment, including information on such phases as (1) quenching media, (2) tempering temperature, and (3) cracking.

Metallurgists feel that engineers should study further the meaning of hardenability conveyed by the bands. The lack of understanding probably is due largely to users not finding out how H-band steels are actually performing in the shop. Virtually no shop complaints concerning H-band steels have come to the attention of the SAE and AISI groups that have been urging the move to H-band specifications.

H-band steel production more than doubled in the 30 days following the middle of August, according to steel producer members of the SAE Iron and Steel Technical Committee.

Iron & Steel Group Shifts to New Plan

PERSONNEL nuclei for the SAE Iron and Steel Technical Committee's five new Panels have been set up by a reshuffling of its membership. New rules and regulations covering this reorganization (See August SAE Journal, pp. 26, 27, 43) recently were adopted by an overwhelming majority vote of the 150 members.

The five Panels, designed to give broad representation to the principal

metallurgical interests of the Society, are: Steel Producers; Castings; Automotive; Tractor and Earth Moving; and Miscellaneous Users Panel. To obtain desired balance, the Executive Committee permitted the addition of several outstanding foundry authorities to membership on the Castings Panel.

Temporary Panel chairmen were appointed to preside at the fall meetings of the Panels and to supervise elections this fall.

During this administrative transition, reports Chairman W. P. Eddy, Pratt & Whitney Aircraft, working groups are engaged in the following technical programs:

SAE and AISI Agree On Steel Make-Up

Discussion of a recently published list of American Iron and Steel Institute steels revealed differences in composition in comparison with SAE steels of the same number. Steps are being taken to reconcile these conflicts so that steels having the same SAE and AISI numbers will have the same chemical composition.

To Publish 27 New Hardenability Bands

Hardenability bands and the purchase of steels by H-band specifications continued to hold the interest of Executive Committee members. Twenty-seven additional bands have been approved by letter ballot for joint publication by the SAE and the AISI along with the 60 bands previously published.

Both steel producers and users on the committee agreed that the principal reason for the slowness of approval of the H-band method of purchase by users is the failure to set forth in strong enough terms the advantages of this new method of purchasing.

Attention was called to the lack of reports showing actual benefits that have accrued from the use of H-band steels. Accordingly, Subdivision III was charged with the responsibility of accumulating experience data covering (1) draw temperature and (2) cracking. Real or imaginary cracking along the high side of the bands seems to be one of the causes of skepticism on the part of some users, a reason which those who have made the greatest study of the subject state positively is invalid.

As a phase of hardenability Subdivision V – whose category is "Method of Determining Hardenability" – after approving the present method of determining hardenability by the Jominy bar as described in the SAE Handbook, agreed that the standard method of shallow hardening tests is quite unsatisfactory. Eight different methods of shallow hardening testing were discussed at length and a cooperative test program to be participated in by 14 laboratories and using the modified L-type test method as a basis was set up. Preparation of a paper on the Rockwell Inch method for possible presentation at an SAE meeting is to be undertaken by F. F. Vaughn, Caterpillar Tractor Co. A. L. Boegehold, General Motors Corp., has also promised many interesting data on a new spiral hardness method using standard Jominy test bars.

Varied Standards Are in the Making

Subdivision recommendations which have received substantial letter ballot majorities of the complete Iron and Steel Technical Committee membership and have been referred to the SAE Technical Board for final approval include:

- Classification of Iron and Steel Arc Welding Electrodes as general information for the SAE Handbook;
- 27 additional hardenability bands to be included in the joint SAE-AISI publication;
- Tentative Recommended Practice covering Automotive Steel Castings;
- Rectification of discrepancy between SAE Recommended Practice and ASTM Recommended Practice in the matter of determination of inclusions in steel;
- Approval of the present SAE method of determining hardenability of steel;
- Glossary of Heat Treating Terms prepared by a joint committee of SAE, ASTM, AFA, and ASM for publication in the SAE Handbook.

Groups Report New Projects

At its November meeting the Castings Panel, headed by F. J. Walls, International Nickel Co., will discuss the advisability of setting up new joint subdivisions with AMS and the SAE Non-ferrous Metals Committee to develop specifications covering Heat Corrosion Resistant Castings and Precision Castings. Also, the Fundamentals of Casting Design will be under discussion.

Interest is increasing in a pearlitic malleable iron specification for selective hardening, according to V. A. Crosby, Climax-Molybdenum Co., chairman of the Subdivision on Automotive Iron Castings. Joint meetings have been held between the SAE Subdivision and a Subdivision of the ASTM.

There appears to be a desire on the part of large SAE users for a broad specification to cover hardness and wear as well as strength to replace the present specification which was held to be satisfactory for strength only.

Other Subdivision activities include consideration of a composition and SAE number for chrome silicon steel used for springs and for a steel whose hardenability is between that of SAE 8700 and SAE 4300 series.

An effort will be made by the Stainless Steel Subdivision to rectify the differences between SAE and AISI stainless steel standards which have been rather marked. The stainless steel numbering system will also receive a thorough going over.

A definite test program is in prospect for the purpose of investigating the properties of cold drawn steel leading to the development of a specification later. Proposed torsion fatigue tests should prove valuable in correlating the properties of various grades of cold drawn steel with the probable use of finished parts.

At the request of the SAE Technical Board, the Iron and Steel Technical Committee took over the Shot Peening Subdivision of the former General Standards Committee's Production Division. J. O. Almen, General Motors Corp., is chairman.

Personnel Changes Announced by Eddy

The Executive Committee approved referring the following personnel changes recommended by General Chairman Eddy to the SAE Technical Board for confirmation:

H. B. Knowlton, International Harvester Co., as SAE representative on ASTM, A-1 Steel Committee; H. A. Moorehead, Carnegie-Illinois Steel Co., as vice-chairman of Panel A, Steel Producers; F. M. Washburn, Wisconsin Steel Co., to succeed B. F. Courtright, same company, on Panel A; O. U. Cook, Tennessee Coal, Iron and Railroad Co., resigned from Panel A; C. L. Kent, Jones and Laughlin Steel Corp., to succeed J. J. Shuman, same company, as a member of Panel A, Subdivision VII (1000 series steels) and Subdivision VIII (1100 series steels); R. E. VanDeventer, Packard Motor Car Co., to succeed W. H. Graves, same company, as a member of Panel E, Automotive, and Subdivision III, Hardenability Bands; E. H. Stilwill, Chrysler Corp., to succeed E. R. Johnson, Republic Steel Corp., as chairman of Subdivision XIV, Alloy Steels, and Howard Smith, Wyckoff Steel Co., to succeed H. B. Knowlton as chairman of Subdivision XVII, Cold Drawn Steel; H. B. Knowlton to succeed N. Deuble as SAE representative on ASTM Committee A1 on Steel; V. E. Hense, Buick Motor Division, GMC, resigned from Panel G but will remain as a member of Subdivision VII, Carbon Steels, and H. B. Chambers, Atlas Steels, Ltd., will replace T. W. Hardy of the same company on the Iron and Steel Technical Committee and Panel A.

CAA Instrument OK To Be Eased by SAE

RECENTLY proposed CAA regulations would put the aircraft instrument maker in a tough spot. He wouldn't be able to get CAA approval for his units until they had been in use in actual operating service – and airlines and manufacturers wouldn't put the instruments in use until they had CAA approval. (Civil Air Regulations, Part CAR 17, Instrument Airworthiness is the impasse-making order.)

An SAE committee, with the approval of both industry and Government, hopes to break the deadlock. It will develop instrument performance specifications. CAA will examine them and approve them, if satisfactory. Then, once CAA has accepted these industry-made specifications, instruments can be built and bought against them without regulatory delays.

CAA viewpoint will be available to the Committee during its operations because CAA engineers as well as technicians from airplane makers, instrument manufacturers, and airline operators will be members of the Committee. The group is SAE Committee A-4, Aircraft Instruments, and its chairman is C. W. Pepperman, Lewis Engineering Co.

Another advantage is that engineering advancements made in instrument design will be more readily incorporated in industry-controlled specifications.

The Committee's program covers specifications for the following instruments:

1. Airspeed Indicator,
2. Altimeter (sensitive type),
3. Pitot Tube (heated type),
4. Rate of Climb Indicator,
5. Turn and Bank Indicator,
6. Altitude Indicator (all types),
7. Directional Indicator (all types),
8. Magnetic Direction Indicator (compass),
9. Fire Detection Indicator,
10. Smoke Detection Indicator,
11. Automatic Pilot (all types).

These specifications will differentiate between minimum performance requirements of personal airplanes not used in instrument flight and both personal aircraft and commercial transports to be used in instrument flight. A special subcommittee will report on environmental requirements for instruments in personal planes.

After drafts of the instrument specifications are carefully screened in committee, they will be circulated among all interested airline operators and airplane and instrument manufacturers. Once the specifications have been refined in accordance with recommendations from industry, they will be submitted to the SAE Technical Board for approval.

A new plan provides that the Aircraft Industries Association serve as a single point of contact between industry and Government on any discussions of regulatory problems.

Members of the newly activated Aircraft Instruments Committee are: Chairman Pepperman; C. E. Patton, CAA; L. N. Swisher, Sperry Gyroscope Co., Inc.; W. O. Stone, Jr., Taylorcraft Aviation Corp:; H. A. Gibb, Consolidated Vultee Aircraft Corp.; C. F. Weber, Kollsman Instrument Division, Square D Co.; A. E. Wetherbee, Pratt & Whitney Aircraft; C. A. Wolf, Eclipse-Pioneer Division, Bendix Aviation Corp.; C. Russell, Republic Aviation Corp., and R. L. McBrien, United Air Lines, Inc.

Aircraft Group Sparks Cheaper Electrical Units

INDUSTRY standards covering every type of aircraft electrical equipment to maintain postwar plane performance at a high level and reduce production costs to a minimum is the star to which SAE Committee A-2 is hitching its wagon.

Dependent upon Army-Navy standards during the war, aircraft and electrical equipment manufacturers are now looking to the SAE Aircraft Electrical Equipment Committee to set on a sound footing electrical equipment design for both commercial transports and personal planes. Intense industry interest in this program is attested by the attendance of 40 guests at the last committee meeting.

In attacking this broad program, the Committee plans to take cognizance of engineering, maintenance, design, and service of each electrical item through specialized subcommittees dealing with individual components.

Edmund Thelen
Chairman

To these working groups Chairman Edmund Thelen, Eclipse-Pioneer Division, Bendix Aviation Corp., outlined the following plan of action to be pursued:

- Review the existing Government standards, recommending necessary revisions to appropriate agencies;
- Determine what industry standards should be developed based on lack of or inadequacies in Government standards, and
- Prepare design standards, test and equipment specifications, detailed drawings, and installation clearance drawings where needed.

Subcommittees agreed upon and men appointed by Chairman Thelen to head each group are as follows:

1. Batteries – H. C. Riggs, Electric Storage Battery Co. Already working on transport and personal plane type batteries, this group is to prepare a report including characteristic curves showing ratings and other descriptive data relative to battery performance and physical properties.

2. Generators – J. E. Mullheim, Westinghouse Electric Corp. Tentative specifications prepared by a previous subcommittee will be reviewed by this new group. An effort will be made to standardize on the 8-in. OD generator.

3. Motors – L. F. Hemphill, General Electric Co. Motor design specifications will be written with consideration given to development of a complete line of standard motors using drives and flanges being specified in a proposed SAE Aeronautical Recommended Practice.

4. Auxiliary Power Units – H. C. Schroeder, Jack & Heintz Precision Industries, Inc. Units as large as 100 kw will be considered.

5. Terminals – J. H. Thompson, Aircraft-Marine Products. This group has already prepared tentative terminal lug standards for aluminum cable. (See SAE Journal, August, 1946, p. 25.)

6. Lights – L. B. Moore, Grimes Mfg. Co. Replies to two questionnaires on this subject indicated a definite need for further standardization of aircraft lighting – particularly for personal planes. CAA also pointed out the lack of adequate standards for landing and position lighting. Several members will be added from the light aircraft field.

7. Limit Switches – W. A. Johnson, Micro-Switch Co. Initial task of Mr. Johnson's group will be the review of three existent Government standards that appear to warrant minor modifications.

8. Maintenance Equipment and Techniques – D. M. McGrath, Eclipse-Pioneer Division, Bendix Aviation Corp. (This subcommittee's report was outlined in the August SAE Journal, p. 25.)

9. Relays – C. A. Packard – Struthers-Dunn, Inc. Major improvement needed in relays is reengineering to seal the unit against effects of environment and make it explosion-proof.

10. Inverters – R. G. Adams, Eclipse-

Pioneer Division, Bendix Aviation Corp. Inverter area requiring standardization will be determined by an industry survey.

Organization of subcommittees dealing with toggle switches, cables, and starters has been postponed by chairman Thelen until problems in these areas develop. To be invited to participate in subcommittee work pertinent to them will be members of the National Aircraft Standards Committee, Aeronautical Board Working Committee, and the CAA.

Special attention is being given to the use of automotive and truck standards for personal plane generators, starters, and relays. This move is receiving added stimulus from light aircraft manufacturers who find automotive epuipment applicable to aircraft use more readily available and cheaper.

In addition to considering light plane requirements in the abovementioned subcommittees, three new groups – power supply, harnesses, and toggle switches – dealing solely with personal plane problems will be organized. An overall specification on electrical system performance requirements is to be prepared under the guidance of W. H. Chatley, Piper Aircraft Co.

Backstopping the SAE Committee's new program will be the AIEE Air Transport Committee. As in the past, the AIEE group will continue supporting and cooperating in the preparation of SAE Standards covering areas common to both committees, strengthening the practical with the theoretical.

Shock Strut Tests To Duplicate Landing

ESTABLISHMENT of a landing gear drop test more nearly simulating airplane landing conditions to determine the gear's shock-absorbing ability was brought closer to realization at the SAE Shock Strut Committee's last meeting.

Improved test procedure is a desired step toward better shock strut design. Aim is to find whether the airplane will land within limits of the landing factor prescribed by CAA. Knowing how the strut will take the landing shock will lead to greater safety. Creation of an acceptable test methodology was undertaken by SAE at the request of CAA.

Chairman C. V. Johnson, Bendix Aviation Corp., reports that Committee discussion boiled down the maze of factors involved in developing such tests to these four salient points:

1. Method of test;
2. Correlation of results on shock-absorbing ability with structural strength;
3. Determination of critical attitude for test, and
4. Prerotation of wheels.

Two schools of thought exist on the method of conducting the drop test. The controversy involves jig testing versus using a complete airplane. Army Air Forces' experience indicates that the jig test is adequate in determining shock-absorbing characteristics. Only reason for drop testing the complete airplane, they feel, is to check structural rigidity and acceleration of the airplane proper.

C. V. Johnson
Chairman

Others point out that reversal of drag loads encountered in landing is not realized in jig drop tests. The jig, they say, is more rigid than the complete airplane when it is drop tested. Thus jig drop tests indicate a greater drag load component than is actually experienced in landing.

But obtaining accurate data in airplane drop tests is not a simple matter. One deficiency in "hard" landing tests of an airplane is the lack of instruments that record satisfactorily the rate of descent.

Tying into the method of test is the question of whether the test should correlate structural strength with shock-absorbing ability. The CAA feels that complete airplane drop tests are necessary to check accelerations in other parts of the airplane in addition to checking the landing gear.

A single attitude – geometric relationship of landing gear to ground – is considered sufficient by some Committee members for drop testing shock struts. Difficulty here has been in reaching agreement among industry and Government personnel as to which attitude is critical. It was brought out that large transports and bombers always land at one attitude whereas landing of smaller planes varies with the skill of the pilot and condition of the landing strip.

To determine the critical attitude, the following criteria were suggested:

a. Attitude is critical in which wheel travel is least or highest shock strut efficiency is required;

b. Attitude is critical in case where shock strut binding is greatest, particularly when combined with high axial loads.

Most members agreed that the vertical drop with prerotating wheels more closely duplicates actual landing conditions than tests such as the inclined platform. Large wheels have a large moment of inertia to overcome upon landing which results in a high frictional drag load. By prerotating the wheels in test, a speed is imparted to them similar to the speed of wheels on a landing airplane relative to the ground.

But similarity in landing drag load by prerotation does not hold for smaller diameter wheels of light airplanes. Major problem in prerotation is determination of the proper speed of wheel rotation.

Concern was expressed over the possibility of unbalancing wheels and tires due to uneven tire wear. Army tests of B-17, B-24, B-32, and B-36 struts showed that after wheels are once balanced prior to starting the tests, no subsequent balancing during the test is necessary.

Since no agreement was reached on any of the above factors, the Committee will solicit industry recommendations in the form of questionnaires to aircraft and shock strut manufacturers to develop a sounder basis for setting up the tests. Preparation of the questionnaire and correlation of recommendations received will be handled in conjunction with the Airworthiness Requirements Committee of the Aircraft Industries Association.

Another job being undertaken by the Committee that promises to aid the aircraft industry and operators is development of maintenance procedures to overcome service difficulties with shock struts and landing gears. Reports on chronic strut troubles will be summarized by personnel from the CAA, Navy Bureau of Aeronautics, and the AAF Air Materiel Command and submitted to the Committee. Such information should prove valuable in arriving at a means of alleviating these difficulties.

Corrosion Experts' Listing Expanding

THE American Coordinating Committee on Corrosion is undertaking revision of its confidential directory of technologists actively engaged in studies on corrosion and its prevention.

Committee membership is composed of delegates from the SAE and 16 other technical societies as well as representatives from industrial research institutes and other organizations such as the National Bureau of Standards. SAE delegates are W. P. Eddy, Jr., of Pratt & Whitney, Chairman of the SAE Iron and Steel Technical Committee, and E.

H. Dix, Jr., Aluminum Co. of America.

The ACCC directory currently lists 500 investigators in a diversity of specialized fields. A questionnaire circulated among the member societies served as a basis for this compilation.

The Committee feels that there are probably individuals who were not reached in previous circulations. For this reason, ACCC now requests all persons active in corrosion research who have not been contacted, to write the secretary for further details and application forms for directory listings. Letters should be addressed to: Prof. Hugh J. McDonald, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Engine Fires Alert Farmers, Airlines

TWO important interests – farming and air transportation – have come into greater prominence as the study of the spark and flame arrester problem progresses. A study of fire hazards in harvest fields indicates that probably the greatest hazard comes from trucks with low exhaust pipes and from fuel trucks. By filling tractor, combine, and other fuel tanks so full they slop over, fuel trucks create a great fire hazard. Records of harvest field fires indicate that many agricultural tractors have tall exhaust stacks which are high above the ground and permit the cooling of sparks and fumes before any damage can result.

A brief investigation conducted by a large air transport company since this project was launched indicates considerable laxness on the part of the airports as well as fuel companies in keeping their grounding devices on fuel trucks in proper condition.

Under present fueling conditions at many major airports there exists a hazard where there are line ups of planes along a ramp, all filled with gas and some being refueled providing the wind is in the right direction. Tanks could overflow and the refueling truck starts up before the gasoline evaporates from the ground.

It is felt that a great deal of the truck hazard is due to dirty engines which are not kept free from carbon.

A survey of State regulations governing fire hazards from exhaust sparks and flames shows that most laws apply to steam engines, locomotives, traction engines and not to internal combustion engines. California appears to be about the only state whose laws covering this category have teeth in them.

The Bureau of Standards is running tests for the War Department and has recently made a contract with the University of Kansas to develop a satisfactory spark and flame arrester. An effort will be made by the SAE committee to cooperate in their project with the University of Kansas as well as the University of Idaho and the work they are doing for the Northwest Forest Service.

It has been decided to broaden the personnel of the SAE committee to include more engineers and technicians from the truck industry, both manufacturers and large fleet users.

Members of the committee agree the most important job first to be done is to arrive at a definition of just what constitutes this fire hazard. That is necessary before the committee can know what kind of a specification will be necessary. Before the definition can be written the committee will consult with large casualty and insurance interests. Because of the claims and losses that have been settled on the farm, in the lumber woods, around refineries, airports and many other places where tractors, trucks and other internal combustion vehicles are used, these companies have accumulated a vast amount of data concerning the nature of the hazards that exist.

Revamp Standards For Plane Wheels

PLANS are rolling for up-to-date aircraft wheel and brake standards to meet needs of manufacturers and users of commercial transports and personal planes.

The new program is under the guidance of SAE Committee A-5. Designed to aid in transition from military to civilian aircraft production, it embodies three major objectives:

1. Development of brake testing specifications;

2. Modernization of existent SAE wheel standards for both transports and light planes, initiating new ones where necessary;

3. Development of a standard questionnaire to assist wheel and brake manufacturers in obtaining information needed to produce these components.

Need for a brake testing standard is critical. At present determining whether a brake functions satisfactorily is largely a matter of pilot judgment. In some cases what appears to be a satisfactory brake to one pilot is unacceptable to another. To eliminate the human factor as much as possible, the committee hopes to establish performance criteria and to arrive at a simple method of testing brakes.

Wheel and axle standardization for air transports is of vital concern to operators, reported Chairman W. H. DuBois, Bendix Aviation Corp. A survey of the industry indicates that such standards can reduce maintenance and ease other problems. By the same token personal plane builders and users would find standardization in this area desirable.

First step in this direction to be taken by the committee is a review of standards previously developed. These include the following:

- AS-181 High Pressure Wheels, Straight Axle Type;
- AS-182 High Pressure Wheels, Stub Axle Type;
- AS-183 Low Profile Wheels, Straight Axle Type, (normally nose wheel);
- AS-184 Low Profile Wheels, Stub Axle Type, (normally nose wheel);
- AS-185 High Pressure Wheels, Stub Axle Type;
- AS-186 High Pressure Wheels, Stub Axle Type, Size 24 x 5-14.

In the realm of light aircraft a proposal is already under way to standardize on low pressure wheels of both the stub and straight axle types. While primarily for personal planes, this series will include wheel sizes up through 12.50-16. The larger sizes are suitable for heavier planes in the transport category.

Design Data Lacking

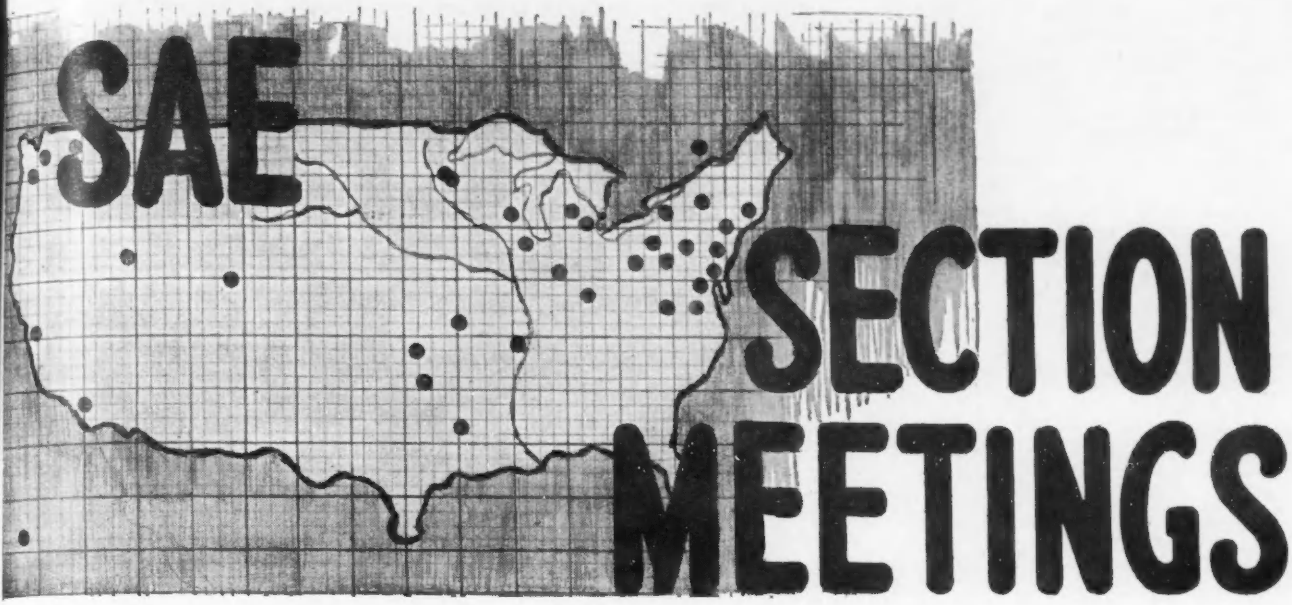
Third project on the program, preparation of a questionnaire on pertinent wheel data, is aimed at the elimination of a real problem in manufacturing relationships. Wheel manufacturers often are stymied on orders from aircraft companies because design information submitted is inadequate.

Typical is a case pointed out at the last meeting. An airplane's static thrust is important to the wheel company in building a brake that will hold the plane on the runway while the engines are run up.

Aircraft manufacturers are reluctant to give this figure; apparently they feel that it suffices to supply only the plane's reaction torque – a factor apart from static thrust. A standard questionnaire form for obtaining this and similar data will go a long way toward speeding the building of satisfactory wheels.

Another project being explored by the committee is the development of specifications covering quality control of wheel die castings.

To broaden its coverage of the transport and personal plane fields, the committee has added as members W. Flinn, Pennsylvania Central Airlines Corp., and C. Kitchell, long associated with personal aircraft manufacturing. Other committee members are Chairman DuBois; R. J. Keller, B. F. Goodrich Co.; B. H. Shinn, Firestone Aircraft Co.; and F. D. Swan, Goodyear Aircraft Corp. J. Vitol, of the CAA, was a guest at the last meeting.



Diesel Advantages Definite but Limited

by J. H. MACPHERSON, Field Editor

NORTHERN CALIFORNIA Section, Oct. 8 – Gasoline engines are lighter and initially cheaper than diesels, and diesels cost and weigh more per horsepower. Diesels, however, are more economical in fuel consumption per hour per horsepower than gasoline engines, and gasoline costs 2½ times as much as diesel fuel. Conclusion, John W. Anderson told this Section's marine diesel meeting, is that the length of time the unit is to be used determines which is the most economical installation. Dividing line at which the diesel installation becomes less expensive than the gasoline engine is over 1000 hr, probably between 3000 and 4000 hr.

Speaking on "Some Marine Diesel Installation Problems," Anderson used tugboats as his example, and pointed out considerations which affect efficiency of such installations. Principal variables in propulsion problems, he said, can be analyzed mathematically to ascertain the effect of tug speed, propeller speed, pitch, and diameter on thrust and efficiency, but many other factors, principally owner requirements, must be considered in any given installation. Although such drive modifications as gear drive and electric drive would permit higher engine speeds and lower costs than direct drive, installation weight would be the same, engine would be heavier and the electric drive would have a 15% loss. Electric drives are, however, advantageous for heavy cargo loading and refrigeration, and their greater flexibility permits constant engine speed at all propeller speeds.

Anderson, who is executive engineer of Atlas Imperial Diesel Engine Co., was introduced by Elton Fox, the Section's vice-chairman on diesel problems. Special guests were President L. Ray Buckendale and Secretary and General Manager John A. C. Warner.

Miller's Combustion Analysis Paper Heard in Philadelphia

by R. W. DONAHUE, Field Editor

PHILADELPHIA Section, Oct. 9 – "Out of the field of hypothesis into the field of theory and out of the field of theory into the field of facts," was Technical Chairman T. G. Delbridge's apt description of Cearcy D. Miller's presentation of his "Analysis of Combustion" to this Section. Before approximately 300 members and guests, Miller exhibited the much-discussed NACA high-speed films of the combustion reaction, including the phenomena of autoignition and detonation.

Pictured at the Philadelphia Section meeting, Oct. 9, are (left to right) John G. Moxey, Jr., Section chairman, T. G. Delbridge, technical chairman of the meeting, Speaker C. D. Miller, and Metropolitan Section Chairman W. E. Conway

The subject matter, reported previously at the SAE Summer Meeting, summarized in the October issue of the SAE Journal, and to appear in full in the SAE Quarterly Transactions, represents, in the opinion of many of those present, one of the most skilful presentations of a difficult subject ever given before this Section. The orientation of the audience into the art of interpreting motion pictures taken at 40,000 and 200,000 frames per sec (a concept difficult to comprehend in itself) and then projected at 16 frames per sec was one of the outstanding features of the paper.

Discussion following the paper centered around a brief description of the camera used in making the films. Among visitors at the meeting were William E. Conway, chairman of the Metropolitan Section, and Lars Eric Larsson of the A. B. Valvo Co., Sweden.

Engineers Hold Key To Helicopter Future

by C. F. FOELL, Field Editor

METROPOLITAN Section, Oct. 31 – An eager market waits for the helicopter to hurdle its engineering obstacles, F. N. Piasecki, president of Piasecki Helicopter Corp., told 300 Section members and guests at a meeting presided over by Vice-Chairman for Aeronautics R. A. Cole.

John Q. Public needs no selling on the helicopter's virtues, the speaker pointed out in his paper, "Engineering

Problems of the Helicopter." Transportation industry already has earmarked many a job for this machine. Satisfying this pent-up demand challenges helicopter engineering to devise a more practical and less costly machine.

Balancing rotor torque is one of the major problems to be reckoned with. Piasecki felt that jet rotors or jet and conventional powerplant may be the answer for lighter craft. For heavier machines, multi-rotors should be the solution.

Powerplants pose another problem. The helicopter has come of age and needs an engine tailored to its own specifications rather than to those of its cousin, the airplane. For example, helicopter power requirements are different; cooling is more difficult; space limitations require a compactly packaged engine in one overall dimension instead of a cube or cylinder.

Little is yet known about helicopter performance characteristics, serviceability, and structural strength. Only way to broaden engineering knowledge on these phases of design, Piasecki said, is by intensive testing.

He closed his presentation with an unexpected treat – colored movies of his company's 10-place helicopter, the PV-3, in flight maneuvers. Interest in both Piasecki's paper and ship ran high – if vigorous discussion from the audience is any yardstick.

Section Chairman W. E. Conway expressed satisfaction with a recently adopted plan of collecting written questions from the floor. Blank forms for this purpose are distributed before the meeting. He said that this method permitted everyone in the audience to hear clearly each question addressed to the speaker as it is read over the microphone.

Quality and Process Control Combine for Better Products

by CARL E. BURKE, Field Editor

WESTERN MICHIGAN Section, Oct. 24 – Quality control, R. H. McCarroll told this meeting, checks physical dimensions of finished material; process control is a running analysis of the steps in the production of a product. Its object is to find and eliminate trouble before the part is completed.

McCarroll showed slides of control charts used in quality control at Ford Motor Co., where he is director of chemical and metallurgical engineering and research. On the charts are plotted dimensional variations of a given part against the number of pieces. One example was bore finish of cylinder blocks in microinches plotted against days. These charts clearly indicate any trend away from the mean of the print limits, and allow corrections to be made before the dimension exceeds the high or low limit.

Process control was illustrated in a slide showing the very complete written procedure given in an open hearth operation. In process control, he said, all procedures are written out in detail in this way to avoid error and maintain uniformity of product. Among machines used are a one million-volt X-ray and a continuous electric inspection machine which performs a function similar to Magnaflux, indicating the existence and location of any defect in a part.

"Science Rules the Rouge," motion picture illustrating research at the Ford plant, was shown following the meeting. Ranging from raw material to the finished car, it dealt also with inspection and testing, pointing out the importance of perfection in all 15,000 parts of the car. Biggest improvements in cars in the last thirty years, the film showed, have been in materials. In iron and steel the use of alloys played probably the biggest part. Other film highlights: a spectograph which gives chemical analysis of a sample in 8 min; an automatic piston pin and valve seat insert inspection machine; and a weather tunnel capable of testing cars at –40 F, in high wind and sleet conditions, at high altitudes, or at extremely high temperatures.

Advantages of Hydraulic Torque Converter Outlined

by D. M. TREPP, Acting Field Editor

NORTHWEST Section, Nov. 1 – Paul E. Forsythe of Western Gear Works described at this meeting the Pacific-Western Torq-Master and its application to the logging field. This is a two-speed air-shifted transmission originally designed to use with hydraulic elements for a better hydraulic-mechanical drive for internal combustion engines. It was first used in the logging industry, and now is in successful operation on various types of logging yarders, used with torque converters and diesel engines. Hydraulic torque converter has two principle advantages, he said:

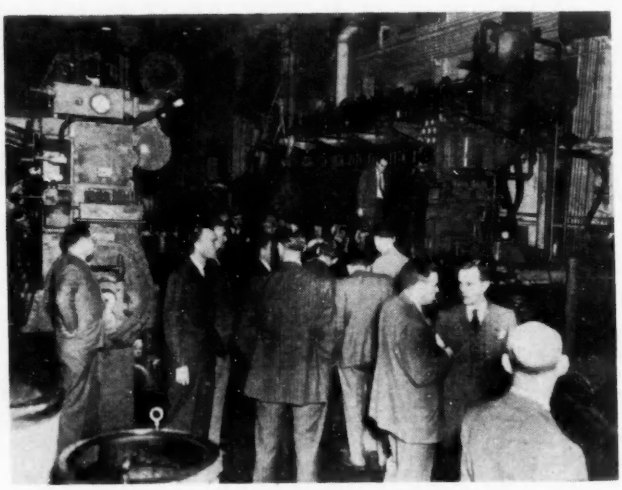
1. Its ability to absorb shock. As a cushion for gears, shafting and cable in the unit, it increases their life and minimizes repairs.

2. Its ability to increase torque automatically as the engine is stalled down like a steam engine.

Robert S. Langdon, staff engineer of Western Gear, assisted in presenting a series of slides showing detailed torque characteristics. Discussion revealed that this transmission soon will be applied to other types of motor truck. Record is good for the first unit, in operation for the past 18 months in the Skagit area.

Worthington Pump Test Setups Investigated by Buffalo Members

by R. J. MARBLE, Field Editor



BUFFALO Section, Oct. 9 – Typical test setup shown here was only one feature of Worthington Pump & Machinery Co.'s Buffalo Works examined today by interested Buffalo Section members. Over 150 members and guests ate filet mignon in the plant's cafeteria, then saw compressors, multi-vee drives and gas and diesel engines of up to 3500 hp, in various stages of production from pattern shop through foundry, machine shop, and erection floor to final test blocks. Of particular interest was Worthington's new dual fuel engine. It changes from gas to oil or oil to gas, manually or automatically while in operation, without perceptible change in rpm.

Air Pickup Successes Imply Extension of Use

by ROBERT B. INGRAM, Field Editor

WILLIAMSPORT Group, Oct. 7 – Human beings can now be picked up by gliders, A. B. Schultz, who is All-American Aviation's chief engineer, told this meeting. Success of the development, which has a probable safety ratio of 99:1, stems mainly from the fact that glider pickup changes the shock into a smooth, even application of force. All-American Aviation, Inc., developer of the technique, believes pick-ups of this type will be extremely useful for peacetime emergencies.

Less spectacular objective of Air Pickup Service, Schultz said, is 24-hr airmail service for any small community in the United States. Only about 30% of the country is served by domestic airlines, because of lack of suitable airports for big ships. Gap is bridged by air pickup service operating as feederlines. The service became self-sustaining in a few years, covers six Middle Atlantic states now, and will some day be extended to all small communities unable to afford large airports.

CLOSING DATE

SAE Journal strives, in these pages, to bring to Society members live, prompt news coverage of every Section meeting. Material is provided by section field editors.

With dates determined by printing schedules, this issue covers all Section meeting news received in New York up to Nov. 15.

Wider Application of Strain Gages Predicted

by ROBERT B. INGRAM, Field Editor

WILLIAMSPORT Group, Nov. 4 – Quoting Lord Kelvin, "Until you can measure the stress in an object, you don't know much about it." C. H. Gibbons of Baldwin Locomotive Works introduced his extemporaneous speech on "Strain Gages."

The speaker gave a brief history of the development of strain gages and pointed out that all (including the present) depended on a multiplication device or amplifier. Early gages consisted of optical, mechanical lever, resistance wire, and carbon-coated paper types.

Common types of strain gages used in industry were illustrated by both sketches and slides. The "A-1" type of strain gage was discussed in detail and Gibbons brought out that 1 out of 50 gages is actually calibrated. The "rosette" type of strain gage was of particular interest to the group in that it gave an average reading of stress applied in 3 directions. This gage was widely used by the aircraft industry during the war.

Instruments used for measuring stress from strain gages vary from a simple micro-ammeter to a magnetic oscilloscope costing up to $50,000. The micro-ammeter is used for measuring stresses that are not fluctuating, as contrasted to the magnetic oscilloscope which measures stresses fluctuating up to 30 cycles per sec.

Gibbons stated that strain gages are widely used in industry and much is expected from them in the future. Applications include measurement of stress in aircraft, tanks, piping, vessels, and building structures. He further brought out that part of the Allied victory could be attributed to the important part played by strain gages in the design of tanks and aircraft.

Especially phenomenal was the growth of this industry. In January of 1940, two gages were sold as compared to 280,000 gages sold in 1945.

The speaker closed the meeting by a series of slides showing various types of strain gages, their application on aircraft, pressure vessels, and so on, and the "torquemeter" costing up to $50,000.

Aircraft Landing Gear Springs Are Evaluated

WICHITA Section, Oct. 14 – Ninety members and guests at this Section's first fall meeting heard two Cessna Aircraft Co. engineers describe Cessna's new single-leaf landing-gear springs. Wichita Section's Field Editor, George W. Baughman reviewed their design and development, and W. W. Moore discussed ground characteristics and service experience.

Baughman pointed out that aircraft landing-gear springs are easy to design and manufacture compared to conventional gears. Springs for truck and bus service do not provide a satisfactory yardstick, for aircraft service is much less severe. Springs are, however, subjected to rigid drop tests, fatigue tests and chemical and physical tests. Throughout development and manufacture, it is necessary to know the chemistry, metallurgical structure, ultimate tensile strengths, elongation, exact operating temperatures of austenizing furnace and draw furnace, so that results of drop and fatigue tests can be properly evaluated. Experience already gained, the speaker said, indicates that further refinements of designs and processes will permit production of lighter springs with service life at least as great as that of present springs.

Important features of the single-leaf landing gear were summed up by Moore:

1. In addition to cushioning landings well, it will continue to absorb loads from extremely hard landings without hitting bottom.

2. Rebound is held to a minimum by dampening effect contributed by spanwise travel of wheels.

3. No maintenance is required: there is no relative movement between parts, consequently no wear.

4. Aerodynamically, its narrow cross section gives low drag and minimum interference.

5. Ground handling of the plane is greatly improved, particularly in high cross winds and at high taxi speeds.

6. The gear's life expectancy actually is greater than that of the plane.

7. Production cost is cheaper since there are fewer parts and fewer operations.

8. Weight advantage can be realized, especially in designs of higher gross weight.

Improved Compressor Efficiency Pays Off

by ARTHUR G. MORAN, Field Editor

BALTIMORE Section, Oct. 10 – Any slight improvement in compressor efficiency of the turbo-jet engine will result in substantial increases in the net power output. But the problem is not an easy one, John F. Victory of NACA said at this first aircraft meeting of the Section year. Huge quantities of air must be compressed at high speeds with a minimum of power taken from the turbine shaft. The shaft must handle from 10 to 15 times the quantity of air passing through a reciprocating engine.

As an example of the field open for improvement, the turbine in a Lockheed P-80 Shooting Star may generate as much as 15,000 hp. But the engine's actual power output under given flight conditions may be only 4000 hp. The remaining 11,000 hp is consumed by the compressor.

W. H. Oldacre

V. C. Young

Karl Effman

Chicago's Oldacre

William H. Oldacre takes pride in being a down-to-facts practicing engineer even though he became a company president in 1941. During more than a quarter century with D. A. Stuart Oil Co. and previous shop and engineering experience with General Electric Co. and Timken Roller Bearing Co. he accumulated a surprisingly comprehensive understanding of lubricants and lubrication. His associates and customers still insist upon consulting him when metal-cutting and lubrication problems get tough – and he loves it. As general manager of the company since 1920, director of research and engineering, as vice-president, and president, he has proved to be a capable executive, but he can't resist continuing to be an engineer.

He is generally known as a fellow who will speak his piece in any meeting, conference or discussion. Ever since he graduated from Hiram College in 1914, he has impressed people with his keen sense of humor and love of a good argument. Combined, these qualities make him a potent participant in engineering society work and the NLGI, ASME, ASTM, ASM, API, ACS and AISE, as well as the SAE, have all benefited from his energetic committee work and lively interest in both technical and administrative problems. He has been a member of SAE since 1929 and was active in the original Lubricants Division and the Subcommittee on Extreme Pressure Lubricants Research. He was the first chairman of the CRC Gear Oil Projects group, which during World War II assisted the armed services in the solution of lubricant problems. He is in popular demand as a technical speaker and has traveled extensively to fulfill engagements in the United States and Canada.

He and the Packard automobile both saw the first light of day during the 90's in Warren, Ohio. He is an ardent fisherman, and a member of the Ridge Country Club where he plays golf. An amateur photographer, he takes pictures of everything from his three grandchildren to etched cross sections of steel by microphotography. He has one daughter. His son, William H., Jr., was killed in action in France on June 19, 1944. – by J. E. Kline, Field Editor.

Detroit's Young

V. C. (Vince) Young, chairman of the Detroit Section, is a quiet-appearing Yankee, but one who seeks out the areas of greatest activity whenever things begin to look dull.

He first demonstrated this as a flying Marine in World War I. Born in Bristol, R. I., and a graduate mechanical engineer from Rhode Island State College, he first enlisted in the Navy because the rolling waves promised action. When he found out that the mosquito boat he was assigned to was on a harbor patrol job, he switched to naval aviation and then – again seeking action – volunteered with the First Marine Aviation Force, which was trained on land-based pursuit planes but wound up doing day-bombing on the northerly seacoast of France.

Back in civilian life, Vince joined International Motor Co. at Plainfield, N. J., in charge of the gasoline engine experimental laboratory, developing powerplants for Mack trucks. At about this time he felt the need of matching experience with others and became a member of SAE.

In 1936 he joined Wilcox-Rich Division of Eaton Mfg. Co., and is now chief engineer. A specialist on valve gear trains, he enjoys everybody's problems and admits that he relishes helping to solve them.

With Bristol the home of famous Lipton Cup defenders, he has an inborn interest in sailing, and has served as chairman of the Racing Committee of the Grosse Pointe Yacht Club. Naturally, his son has gone into the Navy and his daughter is married to a Navy doctor.

Besides sailing, his major outside interests are golf, bowling, bridge and the SAE. He has served on many national SAE committees and was vice-chairman of the Detroit Section last year.

He has studied the results of Section meetings in an attempt to stimulate the interest of others and to maintain a high level of attendance. His analysis of meetings involved plotting attendance figures against such variables as date of meeting, subject matter, speaker, dinner or non-dinner meeting, and so on. His conclusion may interest other SAE officers and members and save them from the efforts of making a similar study. He says: "After trying to decipher the hen-track plots, I just couldn't figure out what makes SAE members click as far as meetings are concerned." – by W. F. Sherman, Field Editor.

Indiana's Effman

A young man with a flair for designing race car motors is Indiana Section's new chairman, 37-year-old Karl H. Effman. He hadn't had his BS from Cal Tech for a year before he was designing 4-cyl racing motors for the

Cregar Corp. in Hollywood. When the plant closed that same year (1931) he went to work for Clarence Tarbet as a race car mechanic – and the next year was designing race car motors for Tarbet at Merz Engineering Co.

After two months with Stutz Motor Car Co. in Indianapolis, as draftsman, and a final fling at racing cars as timer and recorder for AAA test runs at

(This is the third in a series of biographies of new SAE Section Chairmen. Field editors write them; three more will appear next month.)

Indianapolis Motor Speedway, he joined the Perfect Circle Corp. in Hagerstown, Ind., working on piston expander development. In 1935 he was Northern California representative for the company.

The Army called him in the fall of that year, and Effman became a junior engineer in the U. S. Engineers Office of the War Department. He wrote specifications for bids on mechanical equipment in the Supply Section.

Since his return to Perfect in 1936, he has come up the line from draftsman through production work, to be engine testing supervisor and, finally, research engineer. – by C. K. Taylor, Field Editor

Weight Savings Are Safe and Economical

by R. W. BIXLER, Field Editor

SOUTHERN CALIFORNIA Section, Oct. 24 – Repeat presentation of last year's Annual Meeting paper, "Aircraft Approach to Automobile Body Design," by Mac Short and W. E. Miller, highlighted this Section's Passenger Car Engineering Meeting at the Biltmore. Consulting engineer Miller and 1943 SAE President Short were both on hand to answer questions after Short's presentation of the paper. Among their statements during discussion were:

- Crash accidents have shown that passengers have been injured less in many cases with light weight car structure, because of its tendency to give under impact and thus absorb shock.
- Low drag characteristics as a means of fuel savings are generally not considered in body design because most automobile operators are not economy conscious, would dislike the probable increase in initial car cost. Low drag body design would contribute much to conservation of natural fuel, but such car design changes will come slowly.
- Buffeting and side blast can be overcome by eliminating sharp corners and sudden section changes, and by installing window and windshield glass flush to the body skin. A full length cover under the car will eliminate interference in the chassis.

E. W. Templin, Los Angeles Department of Water & Power, suggested that a truck line operator could afford to spend about \$3.50 to \$4.00 per lb weight reduction . . . or about \$2400 for an 800 lb truck weight saving . . . and break even on the initial cost for the truck's life. Miller agreed, quoting one authority who placed the valuation at \$2.00 per lb saved per year.

Section Past-Chairman Gerthal French reported observations made during a filling station survey:

- Average car owner doesn't know the per-gallon price he pays for gasoline.
- About 84% of car owners remain in cars when buying gasoline. Only 16% check gasoline pumps.
- Average owner cannot name other products sold at filling stations where he buys gasoline.
- In short, most automobile owners are not economy conscious.

Scooters, Lawnmowers Played Early Part in Engine Growth

by L. A. WILSON, Field Editor

MILWAUKEE Section, Nov. 1 – Small gasoline power units are in great demand, Leo Lechtenberg reported in his talk on "Small Air-Cooled Gasoline Engines," presented before 175 members and guests of this Section.

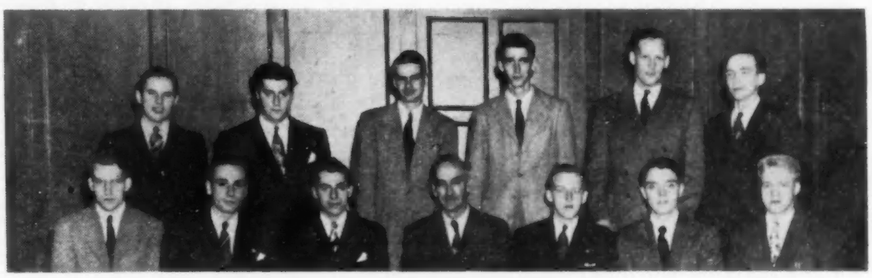
Lechtenberg, who is development engineer for Briggs & Stratton Corp., reviewed the historical development of his company's engines, starting with the purchase in 1919 of the famous "Smith Motor Wheel," a unit built for propelling a bicycle. Soon a scooter was produced that received considerable press publicity when Ann Pennington rode one down Atlantic City's boardwalk. The power lawnmower came next. In all these engines the inlet valve was opened by suction.

In 1926 an entirely new engine design was developed, employing overhead valves and dual blowers. At that time the chief application turned out to be not lawnmowers but rural washing machines. The increased engine height from overhead valves proved disadvantageous, and an L-head engine with mechanically-operated valves was developed. This was quite popular for almost 10 years. In 1936 this engine was superseded by a new model, an engine with 2-in. bore and 1½-in. stroke, the basic design of which is in use today.

Slides illustrated some of the current design features of Briggs & Stratton engines. They are equipped with a vacuum breather which maintains a vacuum in the crankcase at all operating speeds, reducing the possibility of oil leaks. Magnet ring for the high-tension magneto is die-cast into the flywheel. Blower fins are an integral part of the flywheel. The steel magnet ring serves a triple purpose: furnishing energy for the magneto; providing much of the inertia of the flywheel, and acting as a steel band to strengthen the flywheel. The speaker said such wheels have been spun at speeds as high as 13,000 rpm without exploding.

Cylinders are produced with a minimum labor cost by a special automatic milling machine (nicknamed "the ferris wheel") which both roughs and finishes the top and bottom of the cylinders at a rate of more than 100 per hr. The operator unloads and loads the castings while the ferris wheel portion of the machine continues to rotate. Other special tools machine cylinders from all possible directions. A multiple tapping machine taps 23 holes simultaneously from three directions.

Engines are inspected rigidly before shipment for power, performance, governing, oil leaks, and so on. Application difficulties arise, however, Lechtenberg said, because too many users expect a 1-hp gasoline engine to behave like a 1-hp electric motor. But gasoline engines are not good for a large overload over short periods of time as are electric motors. Recommendation, therefore, is that users never design for more than 85% of maximum bhp.



Twelve SAE student members from the University of Wisconsin attended Milwaukee Section's Nov. 1 meeting. Seated (l. to r.) are J. D. Woodburn, president, G. F. Forgue, G. J. Heberer, Prof. L. A. Wilson, faculty adviser and Milwaukee Section field editor, W. O. Trueblood, G. A. Holloway, and F. E. Hillery; standing (l. to r.) are W. M. Cannizzo, H. W. Hertzberg, F. A. Pitschke, J. E. Hinkley, treasurer, H. W. Husting, and O. K. Maki, secretary.

Plastics Deglamorized in Down-to-Earth Evaluation of Virtues and Drawbacks

by W. F. SHERMAN, Field Editor

DETROIT Section, Oct. 21 – Exacting requirements and tests are being applied to the plastics used in automotive construction, according to N. J. Rakas, who addressed this meeting of the Detroit Section in the Horace H. Rackham Educational Memorial Building. He based his discussion largely on the experience of the Rubber Plastics Laboratory, Chrysler Corp., with which he was then associated. (He has since joined the Fisher Plastics, Newton, Mass.)

Differentiating between the glamorous publicity that has been focused on things like the all-plastic automobile, and the practicality of present uses of plastics, he described applications, discussed the "where" and "why" of plastic materials limitations, and supplied information about the unsuitable materials, as well as those which were finally selected.

The cellulose acetate butyrate material employed in steering wheels is subjected to laboratory temperature aging tests ranging from –40 F to 180 F. This material has performed satisfactorily on passenger cars as well as on Army trucks. Both laboratory investigation and road tests are required before final selection of the materials. Aging tests are regarded as particularly important. A cyclic program is followed, with a completely molded and finished steering wheel subjected to the following:

24 hr at 175 F dry humidity;
24 hr at –40 F;
24 hr at 175 F at 65 to 70% relative humidity;
and 24 hr at –40 F.

Initiated in 1939, this test is now a Chrysler standard, besides being similar to what is now an ASTM Standard.

During this aging test the plastic must not crack at any point. The results obtained agree with actual service results and it is now the practice to perform the same tests for routine control of quality in production.

Two mechanical tests are performed on the steering wheel. They are known as a "cantilever" test and an "impact" test.

The steering wheel used in the cantilever test is an aged wheel which has been cooled for 12 hr at – 10 F. Mounted on a test fixture at the hub, the wheel is subjected to a 200 lb load applied downward at the rim at right angles to the plane of the wheel. Conditions include: (a) division of the load at each side of one of the spokes, and (b) concentration of the load at a point on the rim equidistant from two spokes. When there are failures in this test the plastic usually cracks at the point of intersection of the spoke and the hub.

The impact test is designed to determine the ability of the steering wheel to withstand the effects of accidents, without breaking so as to injure the driver. In this test the aged wheel is mounted approximately as in an automobile and a 100 lb sand bag is swung from a height of 30 in. Neither splintering nor shattering of the plastic, nor failure of the welds of joints on the metal inserts of the wheel is acceptable.

To date, Rakas said, only three plastics (cellulose acetate butyrate; ethyl cellulose, and elastromeric polyvinyl chloride acetate) can be classified as being satisfactory in meeting the prescribed requirements. Cellulose acetate butyrate, which is now used in production, is less costly than ethyl cellulose. The non-rigid vinyls are the least expensive but are not used because they mold with a poor surface gloss and show pronounced flow lines.

Phenolics, such as wood flour filler or cotton floc filler, have shown failures in impact tests and it has been found that wheels molded of shredded canvas or cord filled phenolics will not meet all requirements. They are difficult to compression mold and do not have satisfactory color appeal. Injection molded steering wheels are about 15 to 20% better than those produced by compression molds, Rakas said.

For glove box doors the cellulose acetate butyrate is found satisfactory, with an insert used to provide rigidity. The need for proper design of the insert was stressed.

In addition, the same plastic is used for:

Bezel Instruments cluster (steel insert used)
Radio Grill (no insert used)
Left End Molding (no insert used)
Right End Molding (no insert used)

The molded red transparent plastic used this year for the first time for stop light lens was described in detail. It is a methyl methacrylate with a color-fast die which does not fade at all in a 500-hr fadeometer test. The material gives the lighting engineer an opportunity to design the part with the proper optics and maintain the design in the molded piece. With glass, a certain amount of the optical design is lost because of difficulty in molding glass with relatively sharp corners and flat surfaces. The plastic is more expensive than glass but this is off-set because there is less breakage during assembly.

Seats of convertibles and certain other models are being upholstered with extruded plastic rattan and also with plastic coated fabrics. The need for proper selection of weaves to avoid expensive damage and wear of clothing was emphasized but their advantages include resistance to rain, snow, sunlight and their ability to be washed readily with soap and water.

SAE Journal Field Editors 1946-1947

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Northwest – Dan P. Cheney
Oregon – J. M. Lantz
Peoria – Earl S. Tomkinson
Philadelphia – R. W. Donahue
Pittsburgh – Murray Fahnestock
St. Louis – No appointment
San Diego Section – R. N. Yeager, Jr.
Southern California – R. W. Bixler
Southern New England – Floyd C. Gustafson
Syracuse – C. W. Simmons
Texas – No appointment
Twin City – Hamilton Lufkin
Washington – Bertram Ansell
Western Michigan – Carl E. Burke
Wichita – George W. Baughman
British Columbia Group – J. B. Tompkins
Colorado Group – No appointment
Mohawk-Hudson Group – Gene O'Haire
Salt Lake City Group – No appointment
Spokane Group – Harvey Meacham
Virginia Group – Jean Y. Ray
Williamsport Group – Robert B. Ingram

Rocket Engineer Analyzes Types of Jet Powerplant

by BERTRAM ANSELL, Field Editor

WASHINGTON Section, Nov. 12 – Three principal difficulties must be overcome before atomic energy can conceivably be used as a fuel for jet engines, H. G. Jones, Jr., told this meeting. They are:

1. High cost
2. Lack of dimensional information, and
3. Harmful radiations.

Jones, who is a member of the Rocket Development Division, Research and Development Service, Office of the Chief of Ordnance, discussed propulsive types of powerplant in two main groups—pure jet and combination jet and mechanical. Pure jets also are divided into two groups—those that carry their own oxygen and those that depend on surrounding air.

Evaluation of various types disclosed that:

1. Rockets have a high specific fuel consumption, but have the distinct advantage of infinite altitude.

2. Turbo-jets have low specific fuel consumption, although it is still about twice that of the reciprocating engine. Turbo-jet engine is much smaller and simpler in construction than conventional engines, and offers great promise for an aircraft powerplant in the speed range of 300-700 mph.

3. Ram-jet is mechanically simple, has no moving parts. Its specific fuel consumption is high, but it offers advantages for supersonic speed ranges. Auxiliary rocket usually is used to obtain the necessary minimum speed of about 1200 fps.

Materials Featured In Panel Discussion

by JAMES E. P. SULLIVAN, Field Editor

DAYTON Section, Oct. 15—Dayton Section, ninety strong, migrated to Columbus for its October meeting. Featured was an afternoon inspection tour of the laboratories of Battelle Memorial Institute, followed in the evening by a panel discussion of engineering materials.

At the dinner hour, Karl W. Stinson, genial Ohio State professor, informally highlighted some recent automotive developments and trends.

For the evening technical session, Section Chairman W. H. Geddes turned his gavel over to Verne H. Schnee, Columbus vice-chairman of the Section and assistant to the director at Battelle. The panel members, introduced by Schnee, were all members of the Battelle Institute staff and specialists in their respective fields.

In discussing light alloys as engineering materials, J. C. DeHaven claimed that, as a result of war production, war experience, and war research, the light alloys had come of age as structural materials. New alloys of magnesium and aluminum and new knowledge about their processing and fabrication, together with favorable economics, assure the adoption of light alloys for engineering purposes. When properly designed, he said, products made from light alloys have the ability to stand the gaff and give better efficiency and improved performance.

Much research has been in progress to develop special alloys for high-temperature applications. According to Dr. O. E. Harder, the second panel speaker, several new alloys for engine applications have appeared, considerable promise is shown for chromium-iron-molybdenum alloys, modified chromium-nickel alloys containing substantial amounts of aluminum and titanium, and cobalt-chromium-nickel and cobalt-chromium alloys.

The value of plastics as materials of construction is related to the utilization of their special properties, said Dr. Frank C. Croxton, in discussing plastics as engineering materials. It was pointed out that corrosion resistance, transparency, low density, and ease of fabrication are some of the properties which should lead to increased use, and that continuing research is leading to the development of new plastic materials, some with unique special properties, and to the development of improved methods of manufacture for plastic products.

Steel castings were discussed by C. E. Sims. Several developments in steel castings were made during the war, particularly in heat treating by quenching and drawing. Steel casting is another way of fabricating steel and does not produce a different material with different properties. Cast steel properties may be predicated by all the rules governing wrought steel. To obtain steel castings of the very highest mechanical integrity, however, Sims believes a certain development period for each new design might be necessary.

T. E. Barlow pointed out that, although gray and malleable cast irons are frequently discussed as a group, they are actually two distinctly different materials. Gray cast iron differs from malleable in the form of the graphite, the character of the matrix, the method of manufacture, foundry practice, and range of analyses possible. According to Barlow, the "section-sensitivity" of gray iron and the pronounced effect of changes in cooling rate on its physical and mechanical properties require that it be specified not only by the physical properties in a given section size and cooling rate.

The outstanding development in wrought steels during the war was the widespread change in attitude toward specifications, according to L. R. Jackson, the sixth and last panel speaker of the evening. Wartime scarcities forced the recognition of mechanical properties, rather than chemical composition, as the basis for specification. Jackson feels that new information and new testing techniques which were developed will go far toward establishing equivalence between steels and contributing to more rational use.

New Hilo Division of Hawaii Section Formed

by C. H. MORRISON, Field Editor

HAWAII Section, Oct. 17—SAE members from Honolulu arrived by plane in Hilo to participate in the organization of the new Hilo Division. Malihini guest was SAE Staff Member Hollister Moore. During the two-day meeting, engineered by John W. Rogers, regional vice-chairman for Hawaii, members held a dinner meeting at Volcano House, on the rim of Kilauea Crater, largest active volcano in the United States, and did some extensive sightseeing in Hawaii National Park.

Moore reviewed the progressive history of the Society, explained its present ideals and aims in a modern engineering world, and stressed the advantages to be realized by collective membership participation. Howard Overman was elected secretary for the newly organized Division, and November 4 set for the next meeting date.

Section news continued on p. 102

Hawaii Section members are shown above at the organizational meeting of the new Hilo Division. At right is SAE Staff member Hollister Moore addressing the dinner meeting

In the presence of Secretary of Treasury John W. Snyder (right), Secretary of War Robert P. Patterson congratulates **K. T. KELLER**, president of Chrysler Corp., after having presented him with the Medal for Merit, the highest honor a civilian can receive for war services.

VICTOR MILLMAN is now connected with Carter Carburetor Corp., St. Louis, Mo., as assistant research engineer.

CHARLES E. SMITH, formerly with Ethyl Corp., is now technical service manager of ACF-Brill Motors Co., Philadelphia, Pa.

CHARLES J. MARSHALL, Nash Motors, was transferred from their Kenosha plant to Detroit, Mich.

ALFRED HAROLD JOHNSON, mechanical engineer, is working in the powerplant laboratory at Wright Field, Dayton, Ohio.

JOHN R. FOGARTY is now superintendent of aircraft maintenance, War Department, Washington, D. C.

A former lieutenant-commander in the U. S. Navy, **C. R. JOHNSON** is now engineer for Shell Oil Co., Inc., San Francisco, Calif.

Formerly chief draftsman, Weatherhead Co., Glendale, Calif., **HELEN C. LOWE** is now engineering draftsman for Ellinwood Industries, Los Angeles.

After receiving his discharge from the armed forces, **STEPHEN M. BATORI** became consultant to the Polish Government.

CHING-HUA TING, a trainee of Westinghouse Electric Corp., turbine division, Lester, Pa., was formerly a student at M. I. T., Cambridge, Mass.

ARMAND L. THIELKER, who studied at Purdue University, has been appointed test engineer, Allison Division, General Motors Corp., Speedway City, Ind.

Having received his discharge from the U. S. Army, **ROBERT L. MENEFEE** is now employed by Ed Fant Buick, El Monte, Calif., in the capacity of service and parts manager.

Leaving the Michigan Gage & Die Co., Detroit, **JOHN W. FEDACK** has become works manager, Oak Gage & Die Co., Royal Oak, Mich.

Formerly customer service representative for Lockheed Aircraft Corp., Burbank, **FRANK P. WEST** has become assistant operations manager for Trans World Airlines, Paris, France.

Previously aeronautical drafting engineer of the McDonnell Aircraft Corp., **DONALD E. CRESSEY** has been named design engineer.

GEORGE A. CONNOR was an instructor in machine shop practice under the War Emergency Training Program and also served as a lieutenant in the Royal Canadian Electrical & Mechanical Engineers. He is now chief inspector, Canadian Vocational Training Program, New Westminster, B. C.

WILLIAM R. KENNEDY, JR., is now service manager of the Pontiac Master Auto Service, Augusta, Ga.

Formerly project engineer of Pesco Products Co., **DONALD L. CHRISTOFEL** has been named process engineer for Melin Industries, Cleveland.

Having been released from the U. S. Navy, **RICHARD JOHN KOERWER** has joined Socony-Vacuum Oil Co., Inc., New York, as junior engineer.

Leaving the Blackhawk Mfg. Co., **GIFFORD A. COOK** has become sales engineer for Exacto Industries, Los Angeles.

The management of the Valley Equipment Co., has announced its new corporate name, Ajax Tractor & Equipment Co., located at 250—7th St., San Francisco. **HARLEY W. DRAKE**, who was branch manager, has been promoted to manager.

Manager of the Dayton office of the Adel Precision Products Corp., **ROBERT H. EATON** has been transferred to Burbank, Calif., as district manager.

Having left the University of California as engineer of the radiation laboratory, **KNIGHT S. CARSON** has become a partner in the firm of Denman Metal Finishing Co., Los Angeles.

A former lieutenant in the U. S. Navy, Bureau of Aeronautics, **KARL BEAVER** is now connected with Ethyl Corp., Detroit.

A recent student at the University of Minnesota, **REMUS N. BRETOI** is now research laboratory analyst at North American Aviation, Inc., Inglewood, Calif.

RETIRES FROM BUSINESS

The management of the Perfect Circle Corp., has accepted with keen regret, the resignation of **MACY O. TEETOR**, vice-president in charge of engineering. Ill health, necessitating an extended period of recuperation, terminated the 23-year period of Mr. Teetor's active participation in the corporation.

He served on the SAE Indiana Section Governing Board from 1937 to 1939, and was a member of the Crankcase Oil Stability Research Committee, Fuels and Lubricants Activity Committee, Crankcase Oil Oiliness Research Committee and the Engine Wear Research Committee.

Members

Having been honorably discharged from the U. S. Navy, **HARRY FRANKLIN HOSTETLER** has accepted the position of fuels and lubricants engineer with Standard Oil Co. of Ohio, Cleveland.

GRANT KELLER has just returned to Purdue University after an absence of two years in the Navy.

EDGAR J. KENT, who was a student at the University of Michigan, is now aeronautical engineer of Curtiss-Wright Corp., Columbus, Ohio.

KENNETH MURDOCH, formerly assistant to the director of planning of American Overseas Airlines, Inc., La Guardia Field, N. Y., was elected assistant secretary of the company at a recent meeting of the Board of Directors.

GRISELL

L. H. GRISELL was elected president, director and treasurer of the Kermath Mfg. Co., Detroit, at a meeting of the Board of Directors. He has been associated with the company since 1942 serving in the capacity of chief engineer, and is a graduate of Purdue University.

DUGGAN

TOM O. DUGGAN, former vice president of Thompson Products, Inc., has purchased one half of the common stock of Hockaday & Phillips, Inc., Santa Ana, Calif., which operates seven stores in Orange County. He was made vice-president and secretary of the company.

McDOUGALD

A. F. McDOUGALD has been named motor coach sales manager of the new White Motor Co. plant soon to start production at greatly augmented capacity in Cleveland. He will direct the sales activities throughout the United States.

ROTH

EUGENE ROTH resigned as chief engineer of the Adrian, Michigan, plant of the Gerity-Michigan Die Castings Co., in order to establish the Roth Plating Corp., of which he is president. His office is at 1720 Mishawaka Ave., South Bend 15, Ind.

JARMY

HOWARD JARMY has been appointed assistant chief engineer of the Muskegon Motor Specialties Co., Mich. He was formerly a lieutenant in the U. S. Army Air Forces.

KISER

CLIFFORD O. KISER has been promoted to assistant chief engineer of the J. I. Case Co., Rock Island, Ill. He had previously served the company as engineer in charge of tractor design.

D. S. HARDER has been appointed vice-president in charge of operations, effective Jan. 1, HENRY FORD II, President of Ford Motor Co., has announced. He will become the staff executive directing all manufacturing and production activities of the company, but will continue to be a director of the E. W. Bliss Co., of which he is president and chairman.

Formerly works manager and vice-president in charge of manufacturing, Ampco Metal, Inc., Milwaukee, **GEORGE K. DREHER** has been appointed vice-president and general manager, of Rogers Pattern & Foundry Co., Los Angeles.

Presently a flight instructor for Northern Air Service, Grand Rapids, Mich., **DONALD P. GARDNER** was associated with Ford Motor Co., as a draftsman.

Resigning from Globe Aircraft Corp., Fort Worth, as wing and empennage group leader, **WALTER M. DAVIES** has joined Culver Aircraft Corp., Wichita, as chief project engineer.

Prior to becoming a partner in the firm of Shock, Bolton & Graham, **FREDERICK R. BOLTON** was a commander in the U. S. Navy.

WARREN F. TEIGELER has been promoted from manager of aircraft sales to sales engineer of Fafnir Bearing Co., New Britain, Conn.

Graduating from Rensselaer Polytechnic Institute, **DONALD JOSEPH SACHS** is a junior detailer for Ex-Cell-O Corp., Detroit.

Assistant development engineer of Baldwin Locomotive Works, Eddystone, Pa., **LEONARD O. MJOLSNES** has been promoted to development engineer.

GEORGE K. FEINBERG, a former lieutenant in the U. S. Army, is presi-

SAE Members Honored

HARVEY S. FIRESTONE, JR., president of The Firestone Tire & Rubber Co., Akron, is shown receiving the Navy Certificate of Achievement for outstanding services by the company during World War II, from Rear Admiral Monroe Kelly.

EARL W. HAEFNER, Airtemp Division, Chrysler Corp., Dayton, was awarded the Army Commendation Award by the Chief of Ordnance for outstanding performance of duty while serving as commander of troops at Ft. Crook Ordnance Automotive School.

Brig.-Gen. A. Thomas, deputy Commanding General for Supply, Air Materiel Command, presents the Meritorious Civilian Service Award Emblem to **FREDERICK E. MOSKOVICS** who served as technical adviser to the supervisor of AMC's Central and Mid-Central Procurement District from 1942 to 1944.

dent of Somerville Automotive Co., Inc., Cambridge, Mass.

JAMES MORTON SCOFIELD who was appointed research engineer of General Motors Corp., Research Laboratories Division, Detroit, was formerly assistant project engineer, Jacobs Aircraft Engine Co., Pottstown, Pa.

Having received his discharge from the U. S. Navy, **ROBERT BOTHFELD** is now attending Horace H. Rackham School of Graduate Studies, University of Michigan, Ann Arbor.

Leaving the U. S. Navy, **LLOYD D. YATES** has accepted the position of instructor of engineering, drawing department, Ohio State University, Columbus.

ROBERT D. WILLS, Standards Department of Morse Chain Co., has been transferred from Detroit to Ithaca, N. Y.

EDWARD M. SHARER has become transmission engineer for General Motors Corp., Allison Division, Indianapolis.

Graduating from Case School of Applied Science, Cleveland, **ROBERT F. RITUPER** has been appointed junior design engineer of the Lord Mfg. Co., Erie, Pa.

NORRIS C. BARNARD, formerly district sales manager for Colonial Beacon Oil Co., Syracuse, has been transferred to their New York office and has been promoted to solvent engineer in charge of solvent sales. He was secretary-treasurer of the SAE Buffalo Section during 1943 and was elected vice-chairman in 1944.

COL. WILLIAM HENRY BOSHOFF, General Staff Corps, has retired from the Army after service since 1927.

Solar Aircraft Co., of San Diego, announces the resignation of **HARRY A. CAMPBELL** from the position of director of research, a post which he has occupied for more than seven years.

LOUIS POLK, president of the Sheffield Corp., Dayton, was elected treasurer of the National Machine Tool Builders' Association at its annual meeting at Quebec.

HARRISON WOOD was appointed New York district manager for SKF Industries, Inc.

CHARLES L. HUISKING, JR., recently discharged from the Army, has resumed his duties as treasurer of Aircraft Screw Products Co., Long Island City, and in addition has been made assistant sales manager.

Prior to becoming industrial engineer and research assistant at the State University of Iowa, Iowa City, **LOUIS MORTON KUH** was junior research engineer at the University of Colorado.

Resigning as senior liaison engineer of Wright Aeronautical Corp., Lockland, Ohio, **GEORGE M. HARPER, JR.,** has become field engineer of Barnsdall Oil Co., Jennings, La.

Upon his release from the U. S. Army Air Forces, **RAYMOND B. LANDIS** has joined G & A Aircraft Corp., Division of Firestone, Willow Grove, Pa., as design engineer.

JACOB M. HORN who was an experimental tractor engineer with Cockshutt Plow Co., Ltd., Brantford, Ont., is now sales engineer for Massey-Harris Co., Ltd., Toronto.

Prior to becoming distributor for Produc-Trol New Jersey Co., Paterson, N. J., **CHARLES VINCENT BONHAG** was with Wright Aeronautical Corp., Wood-Ridge, N. J.

ELMER J. BARTH has been promoted from chief draftsman to chief engineer of mechanical transmissions for Spicer Mfg., Division of Dana Corp., Toledo, Ohio.

WILMER R. DECKER, JR. has become a part owner of Matty's Auto Repair, Lyndhurst, N. J.

RALPH R. TEETOR, president of The Perfect Circle Co., announces the company's new name, The Perfect Circle Corp. No changes have been made in the executive organization.

GEORGE V. ALTERMATT who was production supervisor of the Air Technical Service Command at Wright Field, Dayton, Ohio is now industrial

specialist of Air Materiel Command, same city.

A graduate of Chrysler Institute, Graduate School, **ROBERT GEORGE RAJALA** has been appointed junior cold test engineer for Chrysler Corp., Highland Park, Mich.

CARROLL A. McSHANE has been promoted from major to lieutenant-colonel, U. S. Army.

RICHARD S. JOHNSON who has been in the U. S. Navy is now analytical design engineer for Pratt & Whitney Aircraft, East Hartford, Conn.

WALTER G. FORTUNE who recently resigned from Baltimore & Ohio Railroad Co., has been named service engineer in the diesel locomotive service department of Fairbanks, Morse & Co., Beloit, Wis.

A former ensign in the U. S. Navy, **ROBERT E. FORBESS** is now connected with Pratt & Whitney Aircraft, East Hartford, as experimental test engineer.

WARREN D. FOLTZ, recently appointed assistant regional manager, Bendix-Westinghouse Automotive Air Brake Co., has been transferred from Pittsburgh to Elyria, Ohio.

HOWARD W. COLE, JR., who was in the U. S. Army, is now connected with Reaction Motors, Inc., Dover, N. J., in the capacity of chief test instrumentation engineer.

P. E. TOBIN, regional manager of White Motor Co., New York City, addressed the N. Y. State Vehicle Maintenance Association on "As You Deliver So Shall You Reap Profits," Oct. 2-8, at the New Yorker Hotel.

ALBERT A. MAYNARD has been appointed assistant chief engineer of the Chevrolet-Cleveland Division of General Motors Corp., Detroit.

Resigning as service manager of Irvin Motor Co., Shelton, Wash., **WALTER N. JAMESON** is now service manager, Keith Motor Co., Amarillo, Tex.

Prior to becoming equipment engineer, U. S. Forest Service, Department of Agriculture, Albuquerque, N. Mex., **HENRY A. MULLIN** was administrative assistant stationed in San Francisco.

JAMES J. WILDER, field engineer, Aircooled Motors, Inc., Syracuse, N. Y. was formerly test engineer of the same company.

GUNN

EARL G. GUNN, who was formerly vice-president in charge of engineering for Fram Corp., Providence, is now doing consulting work including projects for that corporation. He was a member of the SAE Passenger Car Activity Committee in 1933.

HIGGINS

J. E. HIGGINS, who was vice-president in charge of Autocar's Philadelphia District has resigned and taken an Autocar distributorship for central Pennsylvania, with headquarters in Harrisburg. He has organized his own company called Truck Specialties Co., of which he is president.

Recently appointed special supervisor of the veteran training program at Essex County vocational schools, Newark, N. J., **ROBERT N. DOBBINS** was a lieutenant-commander in the U. S. Navy.

Prior to becoming assistant professor of engineering mechanics at the University of Toledo, **CARL J. EATON** was spark plug engineer of the Electric Auto-Lite Co., Toledo.

JOHN A. BOLL was named manager of the newly formed Detroit Division of United States Rubber Co. His territory will include the Cincinnati, Cleveland, Indianapolis, Pittsburgh and Detroit districts.

ROBERT JAMES KRAUSE, recently discharged from the Navy, is now aerodynamicist for Bendix Aviation Corp., Pacific Division, Hollywood, Calif.

ST. HILAIRE

FRANK D. ST. HILAIRE has been appointed aviation technical representative for the Texas Co., foreign operations department, Miami, Fla., handling technical service for the airlines operating in Latin-America.

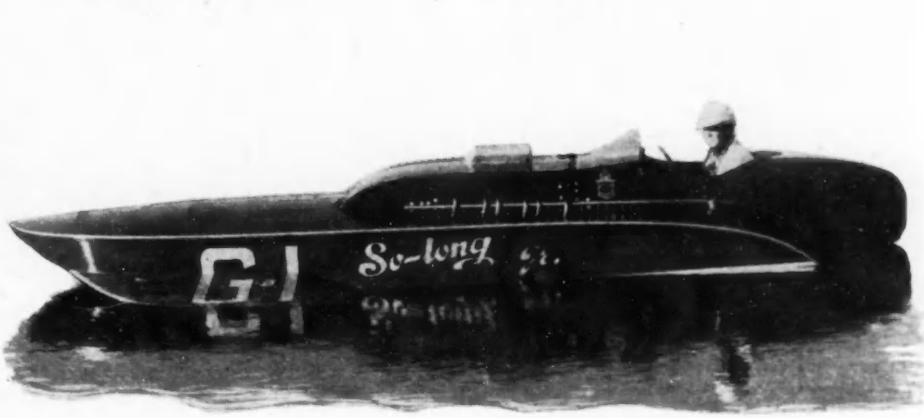
JACKSON

A. VERNE JACKSON has joined the Muskegon Piston Ring Co., as a sales representative in their Detroit office. He has had broad experience in automotive and industrial engine design, and for 13 years was a project engineer in the central office of the Chevrolet Motor Co.

A student at CCNY, **NORMAN ROSEN** is now serving in the U. S. Army.

LEWIS W. PIFER is president and chief engineer of Pifer Industries, Inc., Durham, N. C. This corporation was formed with the purpose of designing, developing, and manufacturing a varied line of magnesium and aluminum products, to be used on automobiles and aircraft.

L. J. FAGEOL, president of the Twin Coach Co., Kent, Ohio, and a nationally known racing sportsman, recently won the coveted Viking Trophy by powering his racing boat, "So-Long, Jr.," with a Fageol Twin Coach engine. The engine was operated at 4000 rpm and produced over 275 hp. He plans to attempt to establish a new world's record for speed craft over the measured mile at Salton Sea, Calif. The company is pointing the way toward possible expansion into the marine engine field.



SAE Fathers and Sons . . .

HENRY FORD

EDSEL FORD

HENRY FORD II

BENSON FORD

A founder member of SAE, HENRY FORD, top center, was elected the first vice-president of SAE back in 1905. His son the late EDSEL FORD, who succeeded the founder of the Ford empire as the company's president, and joined SAE in 1925, is shown at the left. HENRY FORD II, company president, at right, was elected a member in 1940, and his brother BENSON FORD became an SAE member in 1942. This appears to be the only SAE grandfather, father, and sons combination.

SAE Journal editors have in hand more than 25 SAE Father and Son combinations, the first three of which are shown on this page.

If any SAE member knows of any such SAE member combinations, your staff would appreciate hearing from you. We will write for photographs, unless members are good enough to send them along.

Informal pictures of the pair or trio are preferred to individual formal portraits, but we will be glad to receive the latter if clear, informal pictures are not available.

Your cooperation will be deeply appreciated —we don't want to miss any SAE Father and Son grouping.

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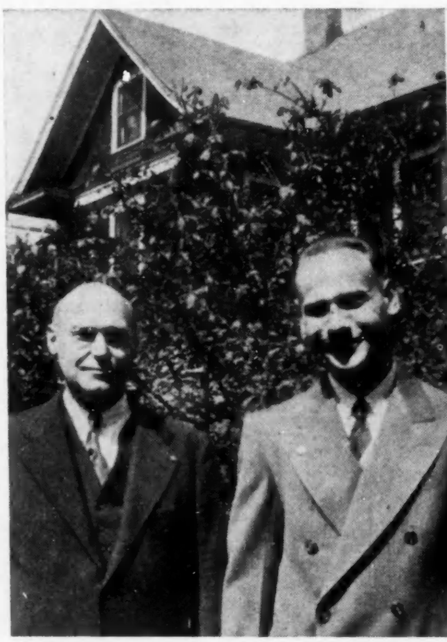
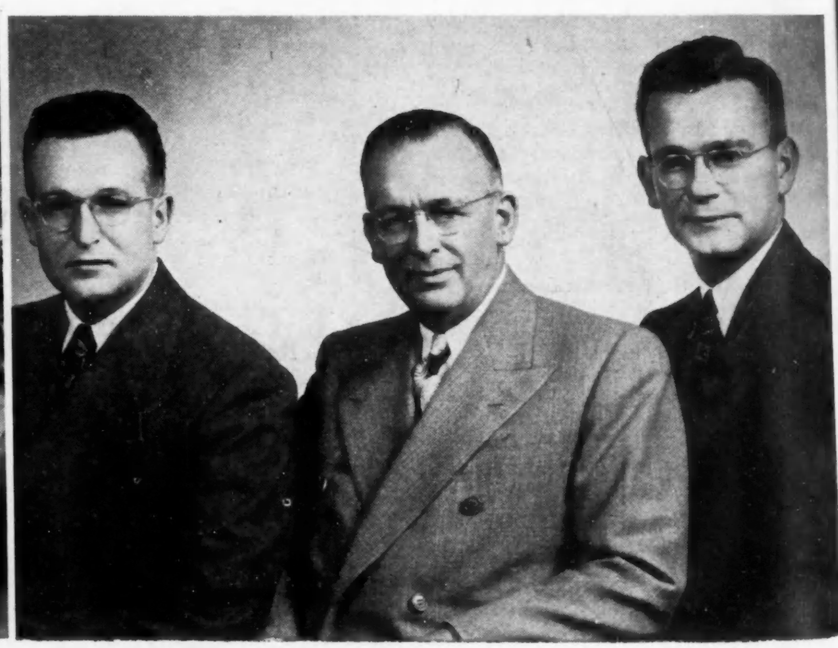


J. V. BASSETT, left, elected to SAE in 1943, with his son JACK V. BASSETT, JR., an enrolled student at the Spartan School of Aeronautics, Tulsa, Okla.



C. L. McCUEN (M '26), vice-president in charge of engineering, General Motors Corp., center, with his two SAE member sons, MARSHALL D. McCUEN (M '43) at the left and NEWELL H. McCUEN, who became an SAE member in 1943. During the war the father served as the SAE member of the Engineers Defense Board.

After having served as a lieutenant in the U. S. Army Force, **ALFRED E. CREEK** has enrolled as a student at General Motors Institute, Indianapolis.

DR. CHARLES ARTHUR NAGLER has been named associate professor of physical metallurgy, Wayne University, department of chemical engineering, Detroit, Mich.

Assistant project engineer of Wright Aeronautical Corp., Wood-Ridge, N. J., **ROBERT ALEXANDER LOOS** has recently been made design engineer of the gas turbine division.

Currently setting up a shop for the veterans administration as part of the Medical Rehabilitation Project, Hot Springs, S. Dak., **ROBERT LACHAPELLE** was a lieutenant in the U. S. Navy.

WARREN H. FARR has been named vice-president in charge of production, The Budd Co., Detroit.

Assistant engineering officer in the U. S. Navy, **ENSIGN CLARKE F. CAREY** was previously a student at Yale University.

ROBERT A. McCLOUD who was chief engineer, Bacon Vulcanizer Mfg. Co., Oakland, Calif., is now design engineer, Food Machinery Corp., Anderson Barngrover Division, San Jose, Calif.

A graduate of Yale University, **JERRY J. MAY** is now secretary, Harry May Chevrolet Sales, Monroe, Mich.

Recently elected junior test engineer of Pratt & Whitney Aircraft Division, United Aircraft Corp., **ROBERT H. WEBSTER** attended Yale University.

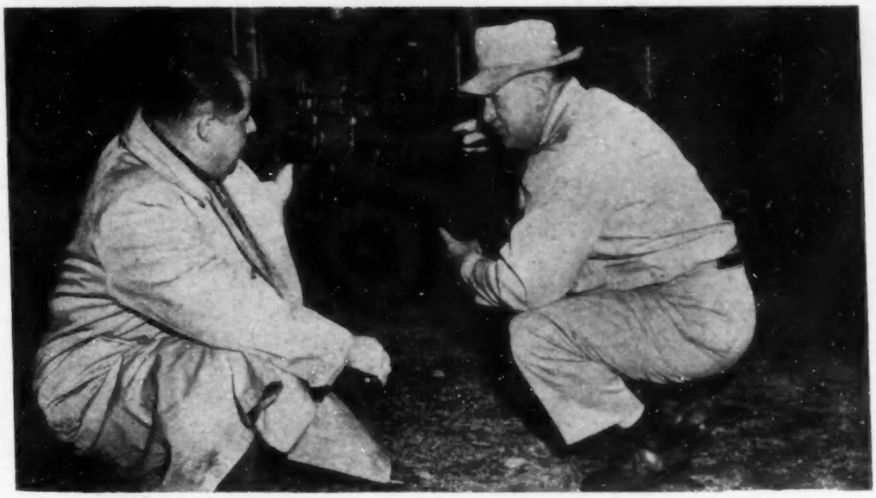
Graduating from Northwestern Technological Institute, Evanston, Ill., **EDWARD WILLIAM RUEHRWEIN, JR.** has accepted the position of project engineer, Electro-motive Division of General Motors Corp., La Grange, Ill.

Previously attending the University of Wisconsin, Madison, **KAY ICHI NAKAGIRI** is now working for the War Department, Corps of Engineers, Omaha, Neb., as mechanical engineer, hydro-electric design section.

J. J. SIMON, recently released from the U. S. Army, is now employed in the testing laboratory of International-Plainfield Motor Co., Raritan, N. J.

W. B. MEREDITH, resigning from Continental Trailer & Equipment Co., Honolulu, T. H., as consulting engineer, will now devote his full time toward the management of his own enterprise in the same city.

J. P. SEIBERLING, president, Seiberling Rubber Co., Akron, presided at the 25th anniversary of the concern on Nov. 16. F. A. Seiberling, co-founder and chairman, and other veteran employees were honored.



J. G. OETZEL, right, executive engineer of Warner Electric Brake Co., Beloit, Wis., and **H. WILLIAM OVERMAN,** manager of Industrial Friction Materials of the Thermoid Co., Trenton, N. J., examine the New Warner Electric Retarder following actual highway field tests at Jennerstown, Pa. Units being installed on tractor and trailer for observation by interested engineers provide better control of tractor trailer trains and contribute materially to the safety of highway operation. This unit is used in addition to the wheel brake.

LEISY

CLIFFORD J. LEISY is now chief administrative engineer of Willys - Overland Motors, Inc., Los Angeles. His experience has extended over 27 years in the aircraft industry covering administrative phases of aircraft engineering as well as design, theoretical and manufacturing fields.

KENDALL

JULIUS KENDALL was recently appointed general sales and service manager for Greer Hydraulics, Inc., Brooklyn, N. Y. He will be in charge of sales, service and advertising throughout the extensive field of operations both here and abroad. He was a lieutenant-commander in the U. S. Navy.

LAURANCE

Resigning as general superintendent of Curtiss-Wright Corp., Buffalo, N. Y. EDWIN N. LAURANCE has become chief tool engineer for the Bellanca Aircraft Corp., New Castle, Del.

JOHNSON

JAMES O. JOHNSON has been appointed assistant general manager of Buchanan Electrical Products Co., Inc., Elizabeth, N. J. Prior to joining this company he was employed by Aircraft-Marine Products, Inc., Harrisburg, Pa. He is a graduate of Rensselaer Polytechnic Institute, receiving his degree in E. E.

BARKSDALE

Having served as vice-president and general manager of the Hydraulic Division of the Saval Co., Los Angeles, for three years, L. S. BARKSDALE has recently taken over as president of the concern. Before that time he was a construction and development engineer.

JOLLEY

MALCOLM P. JOLLEY, whose award of the O. B. E. was announced in November, is shown here. He is assistant general manager of the Canadian Acme Screw & Gear Ltd., South Toronto, Canada.

Previously sales engineer of Westinghouse Electric Corp., Los Angeles, **ARTHUR G. KANE, JR.** is now in the Army.

Resigning as manager of Trans World Airlines, Kansas City, Mo., **GEORGE C. PRILL** is now technical assistant director of safety, Pan American-Grace Airways, Inc., Lima, Peru.

Prior to being commissioned an ensign in the USNR, **EMILE LOYOLA PROVOST** was a student at M. I. T.

Formerly acting head of the aeronautical engineering department of Cornell University, **CYRIL W. TERRY** was promoted to research associate of the University's department of agricultural Engineering, Ithaca, N. Y.

Graduating from M. I. T., **BETTY L. BUNTE** is now aerodynamicist at Boeing Aircraft Co., Seattle, Wash.

TAO-SHENG LO who attended the University of Michigan is now employed as detailer for Giffels & Vallet, Inc., Detroit.

JOHN G. WILSON who was formerly working for the NACA in Cleveland is now assistant research engineer, Engineering Research Associates, Inc., St. Paul, Minn.

MARCUS A. CLEMENTS, formerly Central Division Service Manager for Caterpillar Tractor Co., Peoria, Ill., has recently been named service manager of the Western Division with headquarters at the Caterpillar plant at San Leandro, Calif.

GERHARD G. THIEM, design draftsman, Fredric Flader, Inc. has been transferred to North Tonawanda, N. Y. from Buffalo.

GILBERT SHAW, formerly with Bakelite Corp., New York, is now connected with Polymers, Inc., Middlebury, Vt.

GEORGE M. RUSSEL resigned from Lockheed Aircraft Corp., Burbank, to become section supervisor of Aviation Maintenance Corp., Van Nuys, Calif.

GEORGE ROBERTSON MILLER has been named assistant to the production manager of Aviola Radio Corp., Phoenix, Ariz.

JON VAN WAGENEN, district manager, Clayton Mfg. Co., has been transferred from Portland, Ore., to Alhambra, Calif.

A former lieutenant in the U. S. Navy, **HOWARD FRANKLIN KIRK, JR.,** is now test engineer for De Laval Steam Turbine Co., Trenton, N. J.

A former lieutenant-commander in the U. S. Navy, **GEORGE THOMAS HAYES** is now project engineer for American Overseas Airlines, Inc., La Guardia Field, N. Y.

MAURICE E. McCANN, who was chief inspector for Le Roi Co., Milwaukee, Wis., has been promoted to superintendent.

JOHN ZJAWIN has been promoted from senior test engineer to research engineer of Wright Aeronautical Corp., Wood-Ridge, N. J.

Having received his discharge from the Army, **CHARLES STUART McKENZIE** has been named development engineer, Detroit Arsenal, Centerline, Mich.

Formerly vibration field test engineer for Curtiss-Wright Corp., Caldwell, N. J., **EDWARD KALUSTIAN** is now vice-president and general manager of Eastern Bakers Supply Co., Inc., Arlington, Mass.

ALAN K. MOON resigned as sales manager of Murphy Motors Ltd., Honolulu, T. H., and is now affiliated with the Pacific Commercial Co., also in Honolulu.

THOMAS L. JACKSON who was chief production engineer for Culver Aircraft Corp., Wichita, Kans., is now engineering design scheduler and estimator for Boeing Airplane Co., also in Wichita.

JOHN F. CREAMER, president of Wheels, Inc., New York, and president of National Wheel & Rim Association, delivered an address before the National Association of Independent Tire Dealers on Oct. 15, at the Biltmore Hotel, Los Angeles, on "Changing Standards and Design of Wheels and Rims."

Leaving Airol Engineering & Mfg. Co., L. I. City, N. Y., **NELSON G. KLING** is now project engineer, Fairchild Camera & Instrument Corp., Jamaica, N. Y.

ROBERT WESLEY KOS is working for the U. S. Government, Ordnance Department, Centerline, Mich., as a mechanical engineer.

Formerly engine design engineer, **A. E. KOLBE** has been promoted to assistant chief draftsman of Chevrolet Motor Division of General Motors Corp., Detroit, Mich.

Resigning as administrative assistant to the general manager of Wright Aeronautical Corp., Wood-Ridge, N. J., **RICHARD SALISBURY HUESTED** has become export representative for Curtiss-Wright Corp., New York City.

A former lieutenant in the U. S. Army, **HERBERT J. HOWERTH, JR.,** has been named sales assistant, Gar Wood Industries, Detroit.

STEPHEN F. PALMER has been appointed manager, manufacturer's sales division, Firestone Tire & Rubber Co. of Canada, Ltd., Ontario.

WILLARD F. BLAKEWAY has resigned from Bendix Aviation Corp., South Bend, Ind., in order to become applied physics research engineer for Douglas Aircraft Co., Inc., Santa Monica, Calif.

BRUCE E. CLARK, formerly in charge of brake development, Chrysler Corp., is now project engineer, chassis engineering division, Ford Motor Co., Detroit.

Previously with the NACA, Hampton, Va., **IRVING FORSTEN** is now junior project engineer, Ranger Aircraft Engines, Division Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.

J. R. MARCHANT has accepted a position with the Kaiser-Frazer Corp., at Willow Run, Mich. He is chief draftsman for electrical design.

ALFRED RICHARD PUCCINELLI, JR., has been promoted from junior engineer to special projects engineer of Pan American Airways, Inc., La Guardia Field, N. Y.

Resigning from Reynolds Metals Co., **EDWARD C. BREINIG** joined Air Products, Inc., Emmaus, Pa., as design engineer.

JOHN P. SHERWIN who was formerly employed by Curtiss-Wright Corp., Caldwell, N. J., is now connected with the Mine Safety Appliances Co., Pittsburgh, Pa., as sales engineer.

ROMAN L. SAILER has been promoted from acting chief engineer to chief technical service engineer of Freedom-Valvoline Oil Co., East Butler, Pa.

After leaving Bendix Aviation Corp., South Bend, Ind., **HERBERT H. THURSTON** became design engineer of the lift truck division, Ross Carrier Co., Benton Harbor, Mich.

WALTER S. TAYLOR left the Glenn L. Martin Co., Baltimore, Md., and has accepted a position with Curtiss-Wright Corp., Columbus, Ohio.

OLAF W. ANDERSEN has taken a position in the aircraft sales department of Aviquipo, Inc., New York.

After being discharged from the U. S. Army, **EDWARD MICHAEL KALIFF** has become a student in mechanical engineering at Rensselaer Polytechnic Institute, Troy, N. Y.

Graduating from the University of Oklahoma, **LEROY ALBERT DIFFORD** has become a junior engineer for the Weatherhead Co., in Cleveland.

LAVERN R. MEYER is now a student engineer, Allison Division, General Motors Corp., Indianapolis, Ind.

CARL J. STRID has been appointed engineer of the sales division, Adel Precision Products Corp., Burbank, Calif.

Previously attending the University of Detroit, VICTOR STEPHEN RYKWALDER is now mechanical engineer for Wyandotte Chemicals Corp., Wyandotte, Mich.

Having received his discharge from the U. S. Navy, WILLIAM W. WATSON has been named planning engineer for Western Electric Co., Inc., Chicago.

Graduating from CCNY, DANIEL D. TODES is now civil engineering draftsman for the Board of Transportation of New York City.

REUBEN WOLK is now employed by the engineering department of the Stewart-Warner Co.'s South Wind Division in Indianapolis.

FRED G. HEIDERER has been elected dynamometer technician of Buick Motor Car Division, General Motors Corp., Flint, Mich.

ARTHUR C. HANSON who is now research engineer, Rock Island Arsenal, Rock Island, Ill., was formerly materials engineer for the U. S. Army Ordnance Department, Washington, D. C.

Resigning from Borg-Warner Corp., FREDERICK CARL BRANDT is now engineer for Harry Ferguson, Inc., Detroit.

Now plant superintendent for the southwest branch of Continental Motors Corp., Dallas, Tex., MURRELL ADAMS was assistant general foreman of the same company.

Previously serving in the U. S. Army, ERIK H. HALVARSON is now an instructor of machine tool operation at General Motors Institute, Flint, Mich.

Currently sales manager, Regent Equipment, Ltd., Toronto, Ontario, Canada, C. W. KIRKPATRICK was with Sun Oil Co., Ltd.

SIDNEY L. SHANNON, vice-president in charge of operations has been transferred from Miami, Fla., to New York.

A graduate of Purdue University JOHN J. SCHAUBLE has become junior engineer of Wright Aeronautical Corp., Wood-Ridge, N. J.

Prior to becoming analytical engineer with Douglas Aircraft Co., Inc., Santa Monica, STANLEY SAWCHYA was affiliated with General Motors Corp., Indianapolis.

WALTER F. SANDERS, who is now president of Mountain Brake & Engineering Corp., Tacoma, Wash., was formerly working for the Ordnance Department.

Previously an ensign in the Navy, JEROME D. ALLYN has become service representative for Bendix Products Division, South Bend, Ind.

A graduate of California Institute of Technology, JACK RAYMOND KETTLER has been appointed a draftsman of the air conditioning group of the mechanical section, Douglas Aircraft Co., Santa Monica.

H. A. SKAGLUND, manager and chief engineer of Lear, Inc. of Calif., has announced the removal of its offices to 11916 West Pico Blvd., Los Angeles 34, Calif.

After serving for five years during the war emergency as principal electrical engineer, Navy Bureau of Aeronautics, JOSEPH W. ALLEN is an engineer with the Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

A former graduate of MIT, DAVID M. DENZER is now serving with Wright Aeronautical Corp., Wood Ridge, N. J.

Serving as a sergeant in the U. S. Army, GUY E. FINOUT, JR., is now junior tool designer of General Motor's Fisher Body Plant, Flint, Mich.

Assistant development technologist at the University of Wisconsin, ROBERT W. FLEMING was formerly in the Navy.

Previously designer for Borg-Warner Corp., GARNETT H. GALLAWAY has accepted employment with Chris-Craft Corp., Algonac, Mich.

EDGAR M. JOHNSON has been named mechanical engineer for Dow Chemical Co., Midland, Mich.

JAMES F. SCHWIMMER who was assistant chief of the powerplant unit, U. S. Army Air Forces, recently was appointed senior design engineer of Airesearch Mfg. Co., Los Angeles.

Previously Ordnance auto and parts inspector, U. S. Army, EARL R. RANKIN has become materials inspector of War Assets Administration, Los Angeles.

Elected to the presidency of Bunting Brass & Bronze Co., in Toledo, Ohio, GEORGE H. ADAMS was formerly executive vice-president. He joined the company as sales director in 1928, and has been a member of the Society for twenty-seven years.

N. R. BUCKINGHAM, who was formerly engineer of the Atlas Drop Forge Co., of Lansing, Mich., has been promoted to the office of vice-president.

Staff assistant for Douglas Aircraft Co., Inc., Santa Monica, JOHN C. BUCKWALTER has been promoted to administrative assistant to the vice-president in charge of engineering.

Having resigned as machine and tool designer for Vulcan Bearing Machine Co., Dallas, ARTHUR C. BLOOMER is now associated with Universal Corp. as chief draftsman.

Upon his return from the Navy, WALTER C. WALLING is now working for the NACA, Moffett Field.

JOHN J. BLOOMFIELD, who is now a consulting mechanical engineer, was previously employed as chief mechanical development engineer of Lockheed Aircraft Corp.

Formerly stress analyst for North American Aviation, Inc., O. L. BRYAN is now engaged in drafting and designing work for Fluor Corp., Ltd.

DON PARKIN has formed his own concern, the Don Parkin Co., in Hollywood, Calif., a sales and sales engineering firm. He had been west coast representative for Continental Motors Corp., Los Angeles.

E. FRANK MORGANA is now associated with the Hoffman Machine & Tool Co., Buffalo, as project engineer.

JACK M. LIPMAN has been promoted from powerplant engineer to assistant staff engineer, Republic Aviation Corp., Farmingdale, L. I., N. Y.

A former major in the U. S. Army, LEO J. KUJAWA is now a consultant and dealer in machine tools and production equipment.

OBITUARIES

ROBERT S. DRUMMOND

Robert S. Drummond, who founded the National Broach & Machine Co., 17 years ago, died Oct. 9 at Detroit's Ford Hospital after a two months' illness. He was president and director of the company.

Well known by the engineering fraternity as a speaker and writer Mr. Drummond was recognized internationally as one of the foremost authorities on gear practice and especially on gear finishing.

Born in Philadelphia, he was a graduate of Lehigh University.

CHARLES C. HANCH

Charles Connard Hanch, automobile industry pioneer, who had been an inventor, writer and automotive business counsel, died Oct. 22, of a cerebral hemorrhage after several weeks of illness.

He retired 12 years ago as head of the national association of finance companies, but he maintained offices as an adviser to the automobile industry.

His greatest contribution was the part he played in achieving a cross-licensing patent agreement among manufacturers removing the danger of patent infringement suits which hampered the industry in its early years.

A specification writer for Harris, Kiech, Foster and Harris, Los Angeles, **MISS RAYDELLE JOSEPHSON** has recently accepted a position as physicist with the Ames Aeronautical Laboratory of NACA, Moffett Field, Calif.

A graduate of Massachusetts Institute of Technology **RICHARD C. MULREADY** is in the research department of United Aircraft Corp., East Hartford, Conn.

A former lieutenant in the U. S. Navy, **FRANCIS P. O'CONNELL** is now associated with the Flintkote Co., East Rutherford, N. J.

WILLIAM FRANCIS KNOUFF who was assistant general superintendent and inspector of the Hudson Motor Car Co., Detroit, is now chief inspector of Fruehauf Trailer Co., Avon Lake, Ohio.

FREDERICK P. NEHRBAS, SR., an industrial executive, has retired from business.

Until appointed administrative engineer of Philips Laboratories, Inc., Dobbs Ferry, N. Y., **ROBERT L. ADAMS** was affiliated with Barnes-Gibson-Raymond Division, Associated Spring Corp., Detroit.

FRANCIS H. CATALDO was promoted from body designer to chief body designer of the Bobbi Motor Car Corp., Birmingham, Ala.

Formerly a student of the graduate school of M. I. T., **HSIAO-TSUNG HUANG** is now chief production engineer of the China Motor Corp., Linden, N. J.

ROBERT HENRY THORNER has recently become development engineer of Smith, Hinchman & Grylls, Detroit, Mich.

M. J. PLAWCHAN has been appointed assistant chief engineer of Federal-Mogul Corp., Detroit.

Now vibration engineer with the Lycoming Division of Aviation Corp., Williamsport, Pa., **LESLIE M. RAWLINGS** was sales engineer with the Perfex Corp., Milwaukee.

FRED L. HAUSHALTER is now associated with Firestone Industrial Products Co., Akron, Ohio.

THOMAS B. RUSSELL has been elected as president of Acme Machines & Tools, Ltd., Toronto, Ont., Canada.

A former lieutenant commander in the USNR, **NORMAN E. CARLSON** has been named instructor of Crane Technical High School, Chicago.

Previously studying at the University of Michigan, **HIRALAL S. DALAL** has left for Bombay, India.

T. A. O'CONNER, Studebaker Pacific Corp., Los Angeles, now has his own dealership in Fullerton, Calif. He was recently elected 1946-47 SAE vice-chairman for Passenger Car Activity for the Southern California Section.

JOHN ROGERS, Continental Trailer & Equipment Co., Hawaii, visited SAE headquarters during a recent trip to the Mainland. He is vice-chairman of the SAE Hawaii Section representing the members at Hilo who recently organized as a division of the Section with plans to hold regular meetings.

ROBERT C. MYERS, Perfect Circle Corp., has been transferred from New Castle to Richmond, Ind.

SAMUEL E. RUSINOFF, assistant professor of mechanical engineering at Illinois Institute of Techology, Chicago, has recently completed the second of two engineering textbooks. The first text, "Practical Descriptive Geometry," is his effort at clarification of the misconstruction of descriptive geometry, and the other, "Practical Shop Mathematic" was designed for general instruction purposes.

RALPH R. CLARKSON has been appointed automotive industry representative for Latex Fiber Industries, Inc., Beaver Falls, N. Y.

Now district supervisor, Interstate Commerce Commission, Bureau of Motor Carriers, Harrisburg, Pa., **FRED E. COCHRAN** was formerly a lieutenant-commander.

Graduating from Illinois Institute of Technology, Chicago, **WILLIAM HENRY CHARLTON** is now a trainee at Westinghouse Electric Corp., Philadelphia.

Previously field engineer, Southern States, Dynamometer Division, Clayton Mfg. Co., **JAMES H. BOATNER** is now regional manager in Alhambra, Calif.

Having left Borg-Warner Corp., Detroit, **GARNETT H. GALLAWAY** has become designer of marine motors, Chris-Craft Corp., Algonac, Mich.

DONALD M. GRIMES is now connected with Kenworth Motor Truck Corp., Seattle, Wash., in the capacity of sales engineer.

EDWARD D. KEMBLE has been named plant manager of Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich.

EMIL A. MALICK, formerly with the Bureau of Aeronautics, is now chief aviation technologist, Sales Technical Division, Phillips Petroleum Co., Bartlesville, Okla.

GEORGE MANN resigned as manager of Auto-Transmissions, Ltd., Coventry, England, and is now a consultant at Meinheim, 19 Redesdale Ave., Coventry.

RICHARD F. MARTIN is now operations engineer of Standard Vacuum Oil Co., Manila, P. I.

JOHN D. NEWTON has been elected research & development engineer of El-Van-Ayer Corp., Detroit.

Among SAE members seen at the Auditorium and on the Boardwalk at Atlantic City during the National Metals Congress were **A. L. BOEGEHOLD**, General Motors Research Div., who was installed at Metals Congress as 1947 ASM president; **F. C. YOUNG** and **GOSTA VENNERHOLM**, Ford Motor Co.; **R. W. ROUSH**, Timken-Detroit Axle Co.; **G. C. RIEGEL**, Caterpillar Tractor Co.; **HYMAN BORNSTEIN**, Deere & Co.; **E. H. STILWILL**, Chrysler Corp.; **P. R. WRAY**, Carnegie-Illinois Steel Corp.; **F. J. WALLS**, **T. H. WICKENDEN**, and **E. J. HERGENROETHER**, International Nickel Co, Inc.; **V. A. CROSBY**, Climax Molybdenum Co. of Mich.; **R. G. McELWEE**, Vanadium Corp. of America, and **T. E. EAGAN**, Cooper-Bessemer Corp.

Formerly senior draftsman for American Overseas Airlines, Inc., L. I., N. Y., **JOSEPH MIODUSZEWSKI** is now a designer for Ford Motor Co., Dearborn, Mich.

Having received his discharge from the U. S. Navy, **HERMAN G. STEIGERWALT** is automotive engineer for United Parcel Service at Hahn Motors Inc., Hamburg, Pa.

ROY F. WEEKS has been promoted from research engineer to experimental and project engineer of Ford Motor Co.'s Engineering Laboratory, Dearborn, Mich.

Resigning from National City Lines, Chicago, **HERMAN C. SEFFKER** has become superintendent of maintenance, Montgomery City Lines, Inc., Montgomery, Ala.

A. M. PERLEY, White Motor Co., has been transferred from San Francisco to Portland, Ore.

Currently assistant chief engineer, Ministry of Supply, Surrey, England, **EWEN McEWEN** was a lieutenant-colonel and also assistant director for the same organization.

J. RODERICK McKENNA is now connected with the Stancil Motor Co., Gainesville, Ga., in the capacity of manager.

HAROLD NUTT, formerly director of engineering Borg & Beck Division, Borg-Warner Corp., was elected vice-president in charge of engineering at the last annual meeting of the supervisory board.

CHARLES A. VIRIOT is now president and general manager of Flertex, Neuilly-sur-Seine, France, manufacturers of brake lining and clutch facings.

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News.. ...OF THE SOCIETY

Harrigan Reports Princeton Event

REPRESENTING SAE President L. Ray Buckendale at the Bicentennial Conference on Engineering and Human Affairs at Princeton University Oct. 2 to 4, William Harrigan reported a consensus that there is today a shortage of 200,000 engineers in this country. This lack of technically educated men will not be overcome until 1953.

Forty speakers presented papers at the three-day conference, of which five were SAE members.

Among the conclusions reached by several speakers were:

Our industries and engineers must learn to recognize desired properties of materials rather than continue in the practice of specifying "type materials," in the interest of conserving the nation's natural resources.

Conversion of coal to liquid fuel will expand our reserves of internal combustion engine fuel almost without limit. Chemically regrouping hydrocarbon structures, as well as electronic activation, is relied upon to achieve this end.

Coonley Heads World Standards

HOWARD COONLEY, chairman of the executive committee of the American Standards Association, has been elected president of the new International Organization for Standardization, the formation of which has just been completed by delegates from 25 nations meeting in London.

Gustave L. Gerard, staff president of the Belgian Standards Association, will be vice-president of the new international organization which will be known as ISO. Headquarters will be in Geneva.

Formation of the new ISO consolidates into a single organization the work of the old International Federation of National Standardizing Associations (ISA) and that of the war-born United Nations Standards Coordinating Committee. The International Electrotechnical Commission is expected to affiliate with ISO shortly.

Members of ISO will be the national standards bodies. The SAE is a member-body of the ASA. Its work will be carried out through technical committees upon which any country may be represented, if it so desires.

The 25 nations represented in the formation of ISO were: Australia, Austria, Belgium, Brazil, Canada, China, Czechoslovakia, Denmark, Finland, France, Italy, India, Mexico, Netherlands, New Zealand, Norway, Palestine, Poland, South Africa, Sweden, Switzerland, United Kingdom, United States of America, Union of Socialist Soviet Republics, Yugoslavia.

Screw Threads Group Visits With British

INTERNATIONAL screw thread unification was furthered by an American delegation of engineers during their visit last month in England. Major mission of the group was to thrash out differences between American and British thread gaging practice.

SAE members G. S. Case, Lamson & Sessions Co., and F. P. Tisch, Pheoll Mfg. Co., were on the 4-man team of not pass British gages, and vice versa. This is due in part to the variations in gaging techniques employed by both countries.

British gages are designed to check both the thread flank and maximum diameter in one operation. In American practice, the flank is gaged by a crest-relieved ring gage in one step. But a second operation follows in which the thread diameter is measured with a micrometer, independently of the flank gaging.

Because of long use, each group is

G. S. Case

F. P. Tisch

experts sponsored by ASA Sectional Committee B-1. The others were W. H. Gourlie, Sheffield Co., and F. S. Blackall, Taft-Pierce Mfg. Co.

Anglo-American gaging differences arose out of the fact that American Whitworth threads would in some cases partial to its own method. Although final agreement has not as yet been reached, the gaging problem was thoroughly discussed and international understanding is on the way.

The question of tolerances will be taken up by both American industry

and a group of British engineers coming soon to this country. Final step in the thread unification program will be a conference scheduled for the spring of 1947 at which the United States, Canada, and England will be represented. The program stems from the Ottawa Conference on Unification of Engineering Standards held last year.

The SAE Screw Threads Committee is working in close cooperation with ASA Committee B-1, of which the SAE and ASME are co-sponsors.

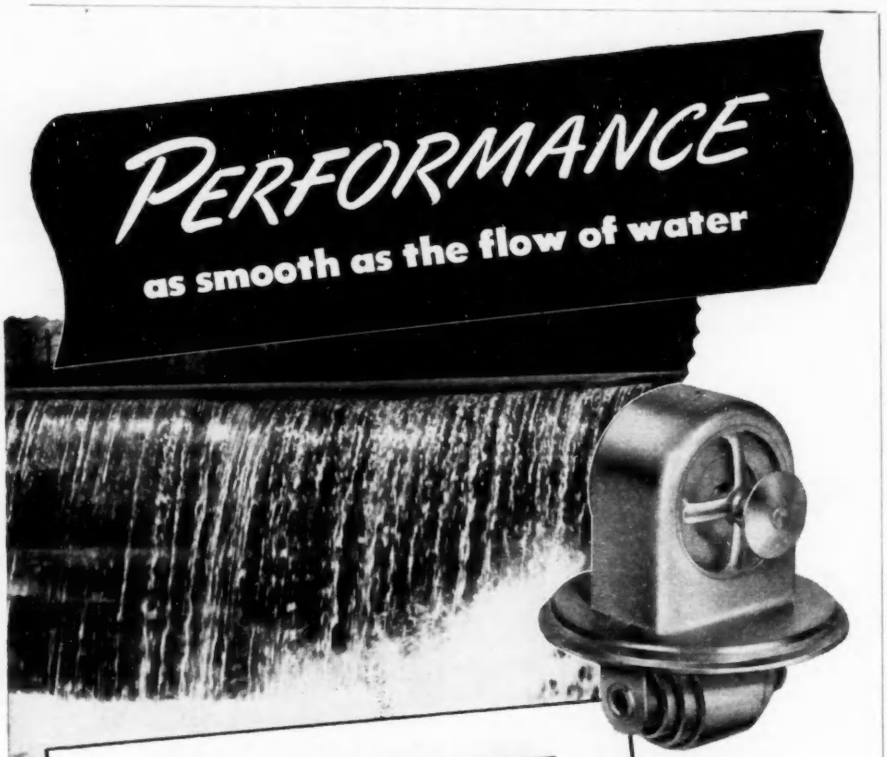
Student Branch News Items

Fenn College

The SAE Student Branch of Fenn College has assumed the sponsorship of the Annual Engineering Paper Contest formerly sponsored by the SAE Cleveland Section. All engineering students in the college have been invited to submit technical papers of 2500 words or less in this competition before the deadline date of Sept. 9, 1946.

Commenting upon the contest in The Cauldron, Fenn College paper, Dean M. S. Spears, of the School of Engineering, said, "I am very glad to see the Student Branch of the Society of Automotive Engineers sponsor a writing contest. The professional engineers who attain the highest standing in their fields are almost invariably those who have an excellent command of written and spoken English.

"I hope that many of the students in the School of Engineering will enter this contest and thus early in their preprofessional life gain valuable experience in the practice of clear, concise writing, which will play such an important part in their subsequent professional careers."



University of Oklahoma

The Mid-Continent Section and University of Oklahoma Student Branch held a joint dinner meeting Oct. 11, 1946, in the Memorial Union Building on the campus of Oklahoma University.

John A. Britton, Jr., manager of both the Synthetic Rubber and Paraflow Sales Divisions of Stanco Distributors, Inc., gave a paper on Synthetic Rubber. "The word 'synthetic' has been misapplied to this material," Britton advised, "since synthetic would indicate it has exactly the same properties as natural rubber. Instead it should be called a synthesis of rubber. It has been developed to the point where, for many uses, it is far superior to natural rubber," said Britton. A color sound film was screened which portrayed the molecular structure of synthetic rubber.

An SAE award was presented to Arch L. Foster, past chairman of Mid-Continent Section, in appreciation of his service to the Section. Foster is Refining Editor of Oil and Gas Journal, Tulsa, Okla.

Purdue University

On October 8, 1946, the Purdue SAE Student Branch held its first meeting of the new semester. Lee Oldfield, well-known automotive engineer from Indianapolis, was the featured speaker. The meeting was in the form of a question and answer session, in which Oldfield answered questions asked by the audience and related examples of his experience in the automotive industry. The discussion resulted in several interesting debates on such controversial subjects as rear-engine automobiles and automatic transmissions. Oldfield concluded by making a plea to the future engineers in the audience to build not only better, but safer automobiles.

California Institute of Technology

On Friday, Oct. 25, 1946, at the first of a series of joint meetings of all the engineering societies at Caltech, the Caltech Student Branch of SAE presented a program on automotive fuels

and lubricants. The speaker was Wallace Linville, President of Acelin Company of Los Angeles.

Linville gave a very interesting lecture accompanied by numerous demonstrations to illustrate his points. The audience was composed of between 125 and 150 enthusiastic students plus several representatives from the faculty.

College of the City of New York

On Oct. 23, 1946, Rene J. Bender of the Sinclair Refining Co. gave an interesting talk to the SAE enrolled students of City College on "Petroleum in the World of Tomorrow."

In the past, Bender declared, the refining process was altered to increase the yield of gasoline, but the growing demand for diesel and fuel oils will probably reverse the trend to yield higher percentages of fuel oils. The finished petroleum products of today will, he announced, become the raw materials of tomorrow. Additives are being added to prevent corrosion, to accelerate flame travel, to improve viscosity index, and to give just about any property you need in a petroleum product. In describing the possibilities of catalysts and in changing substances, Bender mentioned that during the war while we were making rubber out of gasoline, the Japs were making gasoline out of rubber!

Although we'll have adequate oil supplies for probably two generations, he reported, the synthetic gasolines made from natural gas are already approaching the price of a refined gasoline.

The spirited discussion which followed Bender's talk indicates the growing interest among engineers concerning petroleum developments.

Studebaker Design Discussed

William Conway, chairman of the Metropolitan Section of the SAE, addressed the City College SAE Branch on Oct. 30, 1946, and gave some interesting data on the 1947 Studebaker car.

The Studebaker designers felt that the postwar public expected major changes in the new automobiles and they chose the airplane as their design theme. The glass enclosed turret-like tops give excellent visibility.

To improve riding comfort the rear seats were moved 19 in. ahead of the rear axle as compared to 8 in. on the previous Studebaker champion. Lower seats permitted low ceilings and the smaller frontal area gives better economy.

Some of the other mechanical improvements explained were the totally enclosed springs lubricated with specially impregnated wood inserts, box member chassis construction, two-part driveshaft practically eliminating inside floor tunnels, self-adjusting brakes, and an automatic overdrive.

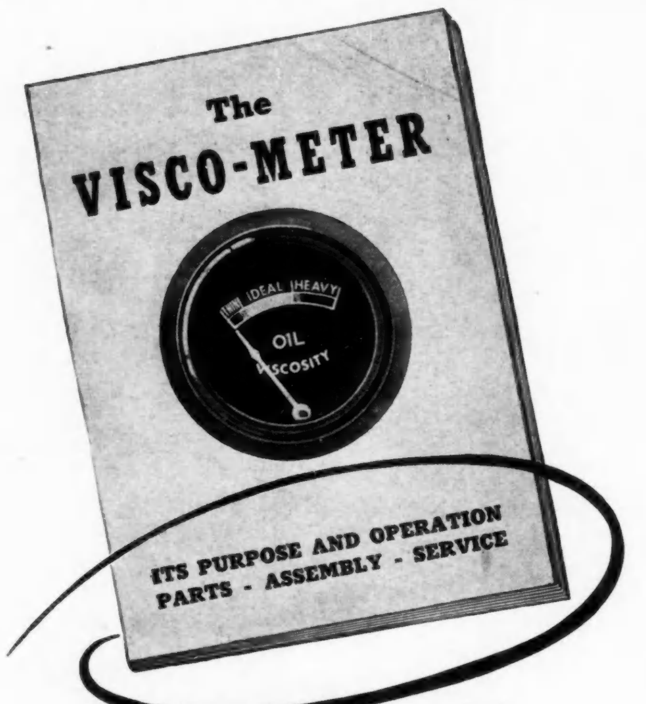
The auto-hungry audience especially

appreciated the color slides which accompanied the talk.

Rensselaer Polytechnic Institute

A joint meeting of the Rensselaer Polytechnic Institute SAE Club with the ASME local student chapter was held at 7:15 p.m. in room 214 Russell Sage Building on Oct. 31, 1946. The meeting was attended by over 40 students. Professor Kenneth White, ASME faculty adviser, introduced the speaker, R. L. Manier of the Industrial Research Gas Association. His talk entitled "Heat Processes in Industry" was concerned mainly with the economic aspects of furnaces used for heat treating metals and with the relative cost of the fuels used when all factors are considered. Though he stressed the good properties of gas, Manier gave an impartial and interesting talk.

Next on the program was a motion picture entitled "The Powerhouse of Aviation" provided by the Wright Aeronautical Corp. It presented a very good detailed account of the mass production and assembly of the Wright Cyclone engines.



ILLUSTRATED IN EVERY DETAIL

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Wolf Discussion of Lubrication Symposium

cont. from p. 51

Department requested the CRC to undertake the job of improving the tests included in the then current gear lubricant specification (VV-L-761), or of developing new tests, around which a new Universal Gear Lubricant specification could be written – one which would be non-restrictive as to the type of additive employed yet would insure the procurement of lubricants capable of meeting current and anticipated military requirements. The other requirement, however, was to improve the quality of the additives, to eliminate sludging at high temperatures and avoid corrosion of the axle components both in the absence and in the presence of water.

It should be emphasized that the success of the VV-L-761 and the 2-105A lubricants in service was due entirely to the fact that the manufacturers of military equipment employed lubricants containing lead soap for the original fill.

The hangover of lead soap from the original lubricant acted as an inhibitor to prevent rapid sludge formation and corrosion when these lubricants were used for makeup or for subsequent refills in the field. For the same reason the sulfur-chlorine lubricants have enjoyed a relatively trouble-free history in the service field in passenger car and truck axles.

However, during the past year a number of cases of failures have been reported in heavy-duty commercial truck axles. These trucks were in service for a long enough period and were drained frequently enough to extenuate the lead soap in the original equipment to such an extent that it no longer served as an inhibitor for the service lubricant.

The additional corrosion tests procedures which have been incorporated into the new 2-105B specification should eliminate these shortcomings of the VV-L-761 or 2-105A types of sulfur-chlorine gear oils and should make it possible to install Ordnance qualified gear oils in new or green axles.

If 2-105B is intended for the initial servicing, as well as for field service, it should be kept in mind that, when the SAE 80 grade is specified for the initial servicing of vehicles delivered during the winter months, the SAE 80 grade must fulfill, under these circumstances, all of the performance requirements of the SAE 90 grade.

Statements by Messrs. Willey and Zwahl may be interpreted as meaning that, while these men are satisfied that the test procedures specified in U. S.

Army Specification 2-105B correlate with the service conditions encountered in the current military equipment, they do not feel that the data available at the present time indicate conclusively that these test conditions correlate equally well with the most severe conditions encountered in civilian passenger car and heavy-duty truck hypoid axles.

In this connection, it is important to note that one automotive manufacturer conducts the high speed and high torque tests under more severe conditions than are specified in 2-105B and supplements these tests with a third axle test in which the ability of the lubricant to properly lubricate the differential member is determined.

It is obvious that the automotive manufacturers would like to recommend the lubricants that have been approved under 2-105B for use in their commercial vehicles, particularly for use in the service field. It is also obvious that U. S. Army Specification 2-105B should adequately cover the requirements of commercial axles, since the commercial equipment of today becomes the Army equipment of tomorrow.

This brings us to the conclusion that either some of the tests imposed on lubricants intended for commercial applications are more severe than are required for correlation with service, or that the axle test procedures specified in 2-105B are not severe enough to insure satisfactory performance in commercial vehicles. These questions must be answered before we can take full advantage of 2-105B.

The petroleum and automotive industries are cooperating on this problem, and I believe we will have an answer to these questions in a very short time.

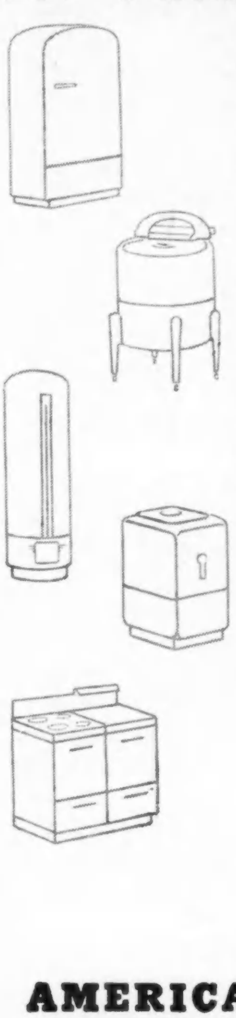
F & L Meeting

cont. from p. 21

may ascertain whether lubricants undergoing laboratory development possess the universal qualities necessary to satisfy the demands of global airlines operation.

Technical discussion of oil and oil filtration, with resulting effects upon engine wear and other phenomena, produced belief that filtration makes an essential contribution to satisfactory lubrication. A paper prepared jointly by O. C. Bridgeman and E. W. Aldrich, of Phillips Petroleum Co., and J. B. Romans, of National Bureau of Standards, reporting the results of experiments with filters conducted at the Bureau, disclosed the importance of the factor of compatibility between oil

**Positive Protection
For Painted Metal Surfaces**



ACP phosphate coatings produce an excellent paint-bonding surface on metal parts and provide a foundation for a lustrous and lasting finish. There are various types depending on the kind of metal, its condition and the purpose for which it is to be used as well as the equipment facilities of the manufacturer. Some of these phosphate coatings are briefly described.

Cold SPRAY-GRANODINE in a short spray time forms a uniform, smooth, zinc phosphate coating—a superior base for lustrous, enduring paint finish. Cold Spray-Granodine is of special interest to fabricators of automobile bodies, fenders, refrigerators, cabinets and in general for proper preparation of sheet steel products for *durable, lustrous finishes.*

DURIDINE *simultaneously cleans and deposits a thin, tight, close-grained phosphate coating* on ferrous surfaces which provide the proper surface preparation for durable paint finish. The Duridine process is simple, economical and effective. Present spray washer installations of mild steel are adequate.

THERMOIL-GRANODINE used in an immersion process creates on steel an oil-absorbing, paint-bonding, crystalline coating of iron and manganese phosphate, integrated with the base metal. Treated surfaces, when oiled or painted, provide excellent protection against rust. Thermoil-Granodine furnishes excellent rust protection for tools, nuts, bolts and unpainted replacement machine parts.

Years of actual experience in the metal cleaning field have enabled ACP to develop chemicals and processes which are giving maximum results in cleaning and surface preparation for paint for varied types of metal and under varying conditions. ACP Technicians have had many years' experience in this field and will gladly consult with you and recommend the ACP products and processes which will most effectively and economically meet your requirements.

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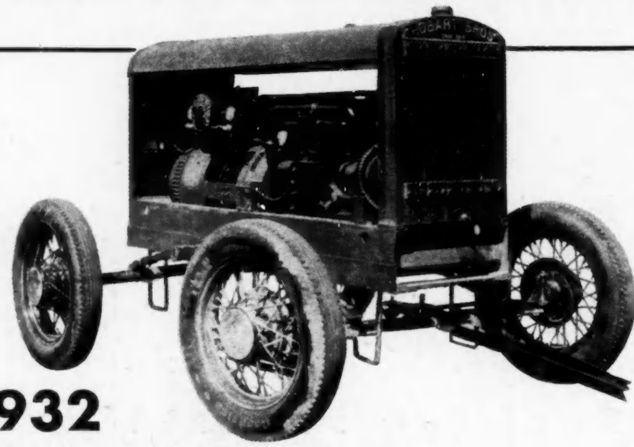
YOUNG PIONEERED WELDED STEEL RADIATOR CONSTRUCTION



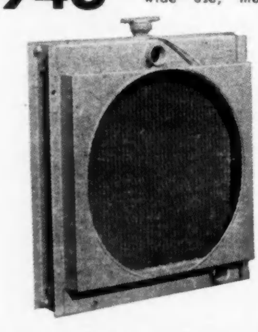
1932

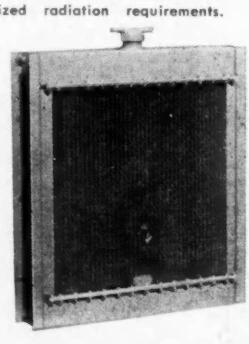
Hobart welding machine using sectional Young Radiator with welded steel header tank construction . . . truly an innovation in 1932.

● Pioneering the use of welded steel for radiators, Young engineers designed the cooling unit for Hobart Bros. of Troy, Ohio, 14 years ago. The success of such early applications and the increasing demand for a radiator built to withstand excessive strains—and severe applications—led to Young's development of an extensive line of welded steel radiator units. Superior in many ways to previous types—particularly in huge locomotive assemblies and heavy industrial power units—Young welded steel construction is rugged, longer lasting, and easily adapted to meet dozens of cooling requirements. Consult Young engineers, without obligation, for answers to your cooling needs.

1946

Today, Young "Mono-Weld" all steel radiators enjoy nation-wide use, meeting specialized radiation requirements.





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YOUNG RADIATOR COMPANY, Dept. 316-M, RACINE, WIS., U. S. A.

and filter. The tests indicated the possibility of developing filters which are efficient with various oils, but no universality is evident. All data resulting from the tests show that all filters remove at least some detergent additives from lubricants and demonstrate that the problem of filtration is made the more complex because different filters show varying efficiencies with different oils.

Filters Serve Purpose

In ensuing discussion, conviction was stated that while filters obviously remove some quantity of additives, clean oil is returned to the engine and basic results thereby are accomplished. Suggestion was made that chiefly the spent additives were removed by filtration, and that oil filters serve the superior purpose of removing potentially destructive materials derived from engine wear, the air, and other operational sources. Proposal was made that more consideration be given to filter functioning under operating rather than laboratory conditions, especially since satisfactory engine performance is the result not only of filter efficiency, but of other factors, including temperature control.

An element of humor was injected into the discussion by C. C. Butterworth, of Chek-Chart Corp., who, explaining the serious problem involved in developing some means of encouraging motor vehicle operators to change filter elements at the proper time, emphasized the need by describing a device which, at the proper time, drew a shade across the windshield to obscure the driver's vision, flashed a light, set in operation a phonograph repetitiously advising immediate attention for the filter and, finally, set in motion a boxing glove which tapped the driver's jaw. Discounting the possibility and advisability of attaching such complex devices to the average motor vehicle, Butterworth proposed that the filter be fitted with an electrical circuit which, when the element reaches the point of requiring replacement, flashes a warning light or sounds a buzzer on the dash.

SAE members learned from Wilbur Shaw, of Indianapolis Motor Speedway Corp., that track racing incorporates fundamental engineering objectives if only because contestants endeavor to accomplish whatever currently may be branded as impossible. After learning from Shaw of the hard engineering work and hectic preparations which precede a 500-mile race, and gaining from the story of his personal experiences on the track a view of the race from behind the wheel, SAE members viewed a motion picture in color of the 1941 races made by J. V. Brazier, of Petroleum Marketing Co.

Among distinguished guests at the

meeting were Capt. G. E. T. Eyston and E. A. Evans, of C. C. Wakefield & Co., London, representing the British Motor Industry Research Association.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Oct. 10, 1946, and Nov. 10, 1946.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: John A. Dilworth, III (J), Charles L. Wight, Jr. (J).

British Columbia Group: W. Howard Bradshaw (A), Fred P. Clark (A), Lloyd T. Graves (M), James Russell Kerr (A), Lyman Burns McPherson (A), Charles O'Brien (A), Harold Puxon (A), Stanley J. Turnill (A), William Herbert Welsh (A).

Canadian Section: Thomas Roy Banbury (A), Arnold Pitt (M), Basil Rabnett (M).

Chicago Section: John F. Novacek (A), Robert J. O'Brien (J), Kenneth Henry Pelgrim (J), Jules A. Taylor (A), Frank P. Tisch (M).

Cleveland Section: Frank E. MacKnight (J), Richard A. Sweet (A).

Dayton Section: Harvey W. Dean (A).

Detroit Section: Robert Anderson (M), Louis J. Aure (M), John D. Bailie (J), Carl Bailys (M), Harold C. Barringer (A), John Edward Brennan (M), Harry W. Brown (A), Carl W. Cowan (M), George E. Curtiss (M), D. Gerald Domes (M), Gay Paul Gaulien (J), William Christian Hahn (J), Philip O. Johnson (J), Roderick Duncan Mac Rae (J), Walter G. Patton (A), Sherwin S. Post (J), Frank O. Riley (M), Charles H. Rose (J), Francis E. Smith (M), Robert K. Spangenberg (J).

Hawaii Section: William H. Bomke (A), James S. Moore (A), Byron B. Peetz (A), Ben L. Silverman (A), James A. Hay Wodehouse (M).

Kansas City Section: W. P. Justice (A).

Metropolitan Section: Henri M. Barat (M), Charles F. Block (A), James R. Bright (J), Donald Bradway Clark (J), Morris Davidoff (J), Patrick A. De Vincenzo (A), Neil P. Flynn (J), Vincent A. Gill (J), Anthony Joseph Giotta (J), Philetus H. Holt, II (M), J. C. Huntley (A), Burton A. Knapp (M), Albert Krinsky (J), Earl A. Leonard (J), Fred P. Leonard (J), Lt. Robert Lee Maxwell (J), Raymond J. McGowan (J), David B. Nichinson (J), Theodore William Osbahr, Jr. (M), Anthony Phillips Pennock (J), Mannie Schneider (J), Arnold A. Staub (A), James Stockman (J), William Bernhard Thelander (M), Jesse E. White, Jr. (A), Marshall G. Whitfield (M), William W. Ziegler (J).

Milwaukee Section: Carl J. Barbee (A).

Mohawk-Hudson Group: John Howe (A), Philip J. Hummel (M), Robert G. Shanklin (A).

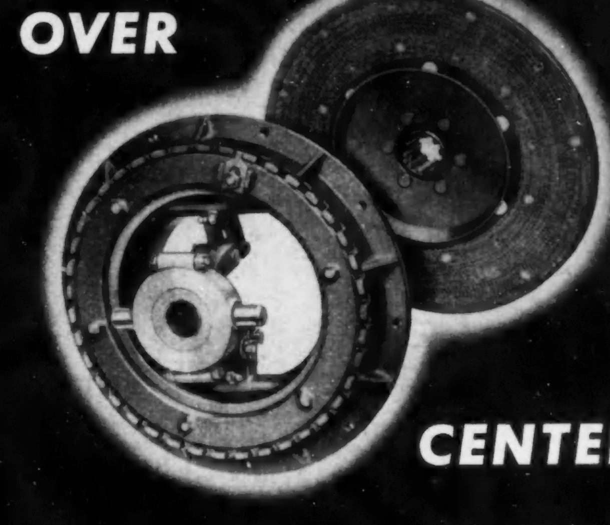
New England Section: Gilbert W. Stevenson (M).

Northern California Section: Melvin O. Brogan (A), Frederick A. Christiansen (M), Ned Cornelius (A), C. O. Gerlach (A), John A. Miller, Jr. (J), Carl E. Watson (M).

Northwest Section: W. O. Harvey (A), Sherman B. Howard (M), Arthur W. Leggett (A), Jack B. Shayler (A).

Philadelphia Section: Gladeon Marcus Barnes (M), Donald L. Grader (J), Lewis

ROCKFORD OVER CENTER CLUTCHES



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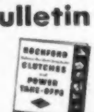

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Salt Lake Group: Dean Edward Kellerstrass (A).

Southern California Section: Phil S. Adams (A), Duane Lee Bennett (J), G. Robert Brainard (A), Allen L. Bristow (A), Kenneth S. Carter (M), Lloyd F. Coates (A), J. G. Derwingson (A), Paul C. Gomez (J), George H. Lindsey (A), Herbert M. Place (M), Leon E. Rope (A), Werner Schwyzer (A), Joseph A. Sharp (A), Joseph Stephen Skurky (J), Lloyd C. Starkweather (A), Gardner W. Stevens (A), Jerome J. Wheeler, Jr. (A).

Southern New England Section: Serge E. Glubareff (M).

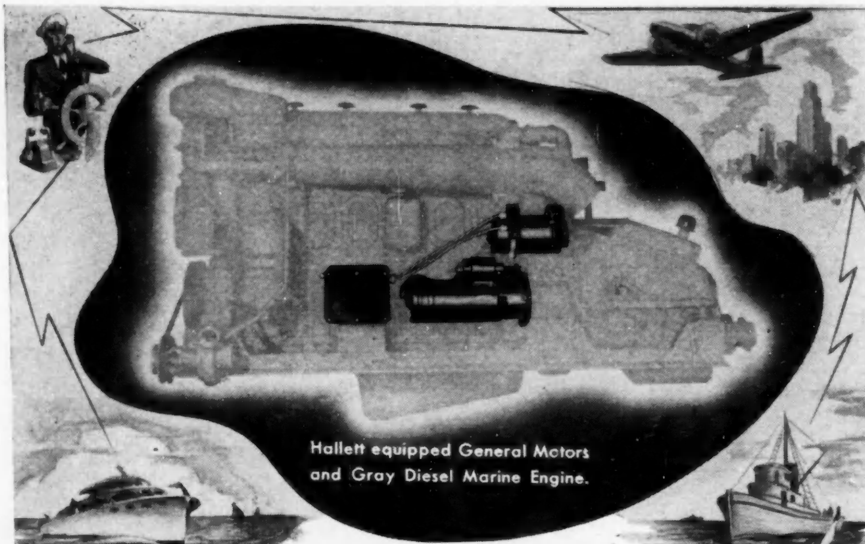
Virginia Group: William H. Bingham (A), C. Delaney Walthall (A), Charles Hamilton Woodward (A).

Washington Section: Samuel M. Lauderdale (A).

Wichita Section: Lyonal N. Copeland (J), E. C. Roth (A), Hobart A. Slingsby (M).

Outside of Section Territory: James F. Bly (J), Howard W. Bottger (A), Pete Y. Burns (J), John L. Colp (J), Charles Hanna (A), Robert P. Humphrey (J), Robert B. Rice (M), Lt.-Col. Alfred John Robbins (A), John J. Tyne (M).

Foreign: J. R. Bouhourd (A), France; Frederick Darnton Holister (FM), England; Czeslaw Kapica (FM), Brasil; Willis M. McComb (FM), India; Vasanji Mulchand Meswani (FM), India; Kenneth Albert George Woodbine (FM), England.



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Applications Received

The applications for membership received between Oct. 10, 1946, and Nov. 10, 1946, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

British Columbia Group: Thomas C. Baillie, W. D. Stewart.

Buffalo Section: Edward C. Ditzen, Ralph Park Maratta.

Canadian Section: Burton Jenner Bourchier, Chesley Raymond Brown, Thomas George Couch, Stanley C. Thomas.

Chicago Section: Vernal A. Anderson, George E. Beringer, Clayton F. Britton, Edward T. Christian, Grant T. Clarke, William H. DuBois, Francis G. Fabian, Jr., Vincent P. Gibney, Conrad Herre, Charles B. Johnson, A. Blaze Juno, C. Hunter Lindsay, Clark R. Lupton, Robert L. Matson, George Scott Minium, H. A. McAninch, Paul W. A. Oberreutter, W. Waits Smith, W. P. Sullivan, Virgil L. VanDinter.

Cleveland Section: Robert M. Geisenheyner, Howard R. Leland, James H. Marcum, Charles M. Ong.

Colorado Group: Major Chet D. Hirsch.

Dayton Section: Frank E. Carroll, Jr., Delco Products Division, GMC, Wilfred E. Metzger, Jr., George Roland Ott, Everitt V. Swenson.

Detroit Section: Roy E. Blue, Emmett W. Bond, Byron F. Campbell, Aymar DeBacourt, Capt. Henry Wilson Fernandes deSouza, William Herbert Evans, Idan E. Flaa, Capt. Arthur Oscar Soares Futuro, J. Dean Garrett, Joseph E. Gray, Harvey T. Hendricks, George V. Hurley, Harold J. Inch, Jr., Finn H. Jensen, K. W. Kithil, Alexander R. Lindsay, Evan Lucas, Harold F. Matthys,

W. A. McKee, James T. O'Reilly, Raymond Dresser Strout, Toledo Scale Co., John J. Werner, Lawrence V. Williams.

Hawaii Section: Kaare Olaus Asper, Robert F. Butler, James McBrien, Daniel Thompson.

Indiana Section: Harmon Grover Stech.

Metropolitan Section: Richard Miller Adams, Howard W. Aldag, Edward L. Asch, Sidney M. Caplan, John Lawrence Carter, Jr., Frank W. Cayea, John H. Collins, Charles L. Davis, Norman L. Derby, Jules Louis Louvet Dromet, John E. Dranke, Robert Emmett Duffy, Clinton F. Egerton, Stuart Hamilton, Charles O. Herb, Stephen Jack, Frederick Van Horne Judd, Michael Walter Klemek, Leonard Levinsohn, Arthur E. McGlinchey, Everett Francis Meadows, Robert Fred Miller, David L. Moore, Edward B. Nisbet, Robert Wright Northrup, Henry G. Osborne, Jr., William N. Plamondon, Jr., Jack Pleasants, John M. Schultz, Carl H. Search, Henry R. Sherwin, Elbridge M. Smith, Anthony W. Sounes, Ernest M. Stolberg, Herbert C. Towle, Jr., Aaron N. Waldman, Robert M. Youngs, Jr.

Mid-Continent Section: Henry Phillip Enders, John H. Thomas.

Milwaukee Section: David Caldwell Gaston, James Arnold Hunter, Jr., Harry Joseph Johnson, Richard A. Wolterding.

Mohawk-Hudson Group: T. Southworth.

New England Section: Ernest Wray Dumler, Maurice W. Persson, Harold E. Sandberg, Ralph U. Starr.

Northern California Section: Albert P. Hahn, Gerald M. Smith, Victor J. Westerfield.

Philadelphia Section: Franklin F. Adams, Charles H. Dessin, Jr., William H. Heermance, Norman J. Law, Charles Ward Leister, A. Milton Miley.

Pittsburgh Section: James J. Logue.

St. Louis Section: Richard F. Piasecki.

Southern California Section: William J. Brennan, Castle R. S. Fernald, K. E. Freund, F. Carl Hirdler, Jr., James A. Hodges, N. Heath McDowell, Glen E. McPherren, G. D. McVicker, John B. Pitkin, Wesley W. Smith.

Southern New England Section: Donald C. Brush, Paul G. Burman, Frank DeLuca, John H. Flaskamper, Walter John Gewinner, Leo Raymond Leggitt, Ernest J. Mailloux, James Dow Thackrey.

Spokane Group: James S. Ray.

Texas Section: Frank V. Esden, Carl L. Larsen.

Twin City Section: Eugene L. Zeimet.

Virginia Group: David T. Ayers, Jr., Henry F. Bickerstaff, Percy J. Carr, Robert L. Schowengerdt, Howard F. Todd, Clarence Harley Wees.

Washington Section: Horace Goo, Lt.-Com. James L. Ingoldsby, James Bernard Jones, Edgar G. Keenan, Fritz Young Mercer, Russell P. Proffitt, Ray B. Roberts, Howard Wilson.

Outside of Section Territory: Russell H. Swartz.

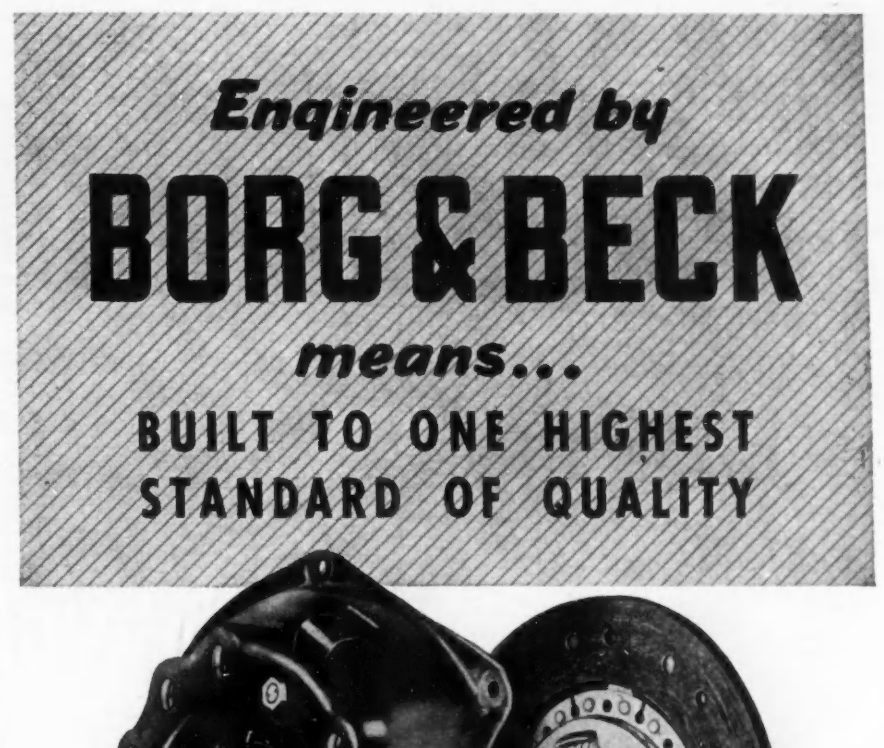
Foreign: A. Fogg, England; V. Krishnaswami, India; R. A. Narielwala, India; Capt. Harold Walter Rogers, England; Johannes Martinus deKock Schutte, South Africa.

Repair Prevention

cont. from p. 68

selves in a short time. With this device a unit can be rated when new and when a service weakness develops. Correction can be proved before the vehicle is released for the road.

Bearings should be replaced when fatigue becomes excessive and prior to fatigue so that the crankshaft will not be damaged.



Failure of transmissions and differentials on the road can mean loss of cargo, inconvenience to passengers, and costly repairs. Preventive maintenance of these units should embody this 4-point program:

1. Proper lubricant and lubrication;
2. Correct level and regular drain periods;
3. Elimination of leaks;
4. Overhaul based on inspection mileage experience.

Chassis lubrication is an important cog in preventive maintenance. Grease rack personnel should be trained to put the correct product, in the right place, in the required quantity, at the proper time. Cleanliness of application and elimination of leaks is a very important part of the assignment.

To round out the preventive maintenance program the record system should be kept useful and informative and drivers should be given a better understanding of their vehicles. (Paper "Further Developments in Preventive Maintenance," presented at SAE Hawaii Section, July 15, 1946.)

Feederliners' Need Is General Streamlining

Digest of paper

by JAMES G. RAY

Southwest Airways Co.

FEEDER airline operators have special problems – and need special planes to meet them.

Short-haul service requires frequent schedules . . . and this means a smaller plane. But economy and low cost per seat are better on a large plane carrying more passengers. Possible compromise design between the two, Ray suggests, would gross about 15,000 lb, carry a payload of 4000 lb (15 passengers plus 1000 lb of cargo). About 1300 hp would be necessary.

Size once established, other requirements must be met as scrupulously as for trunkline service:

- There must be no letup in safety provisions.
- Schedules must be reliable: much of the traffic will connect with trunklines, and passengers will not tolerate delays.
- Reliability will have to be built into planes: at least two engines with ample single-engine performance; adequate deicing equipment; complete instrumentation; and better radio and navigation equipment.
- Feeder planes must be capable of operation from the small airports small towns will be able to provide.

With these requirements met – and Ray is confident they will be – designers can concentrate on overall aircraft efficiency, in an effort to get as much performance as possible with a minimum of power. (Paper, "Some Requirements of a 'Feeder' Airplane," presented at SAE National Aeronautic Meeting, April 5, 1946.)

Section News

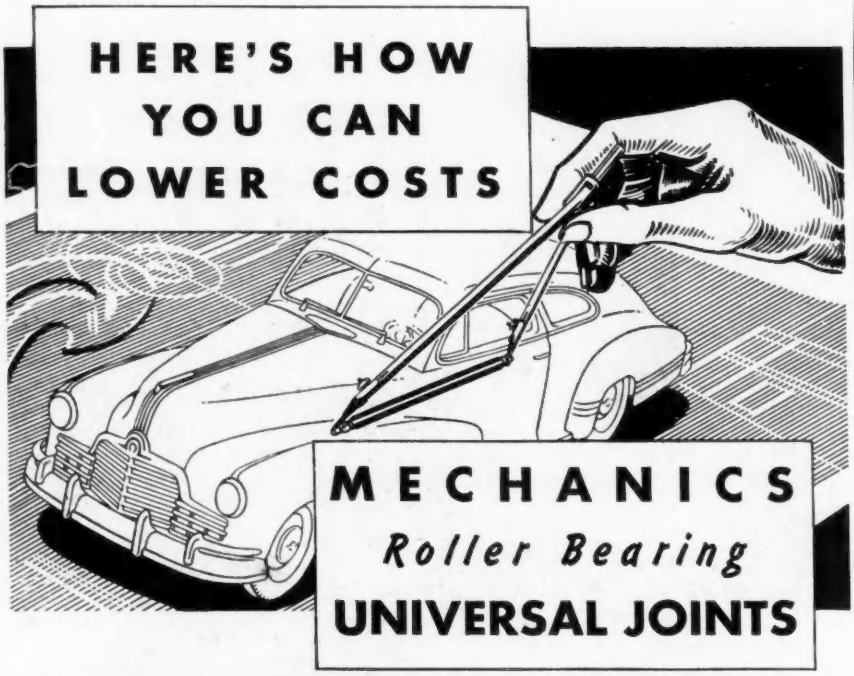
cont. from p. 83

Earthmoving Tires At Panel Meeting

by EARL S. TOMKINSON, Field Editor

PEORIA Section, Oct. 28 – Earthmoving tires were featured at this meeting in a panel discussion by Lee W. Fox of Firestone Tire & Rubber Co., M. A. Wilson, Goodyear Tire & Rubber Co., and Robert Evans, Caterpillar Tractor Co.

Fox reported that experience shows larger single tires to have several ad-



The slip-on-the-transmission-shaft feature of this MECHANICS Roller Bearing UNIVERSAL JOINT eliminates the need for the conventional splined stub shaft, thus reducing cost and weight. Let our engineers show you how this and other MECHANICS features will help give your product competitive advantages.

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vantages over dual installations. Among these are easier rolling, easier riding, greater impact resistance, elimination of shifting of tire load on uneven roads, and prevention of trapped stones and trash between tires.

New cord materials—light and heavy rayon, nylon, and steel wire—give greatly increased tire strength with fewer plys. Wire cords have many advantages, and are just beginning to be commercially available; they are, however, premium-priced and sensitive to under-inflation.

Continuing the discussion, Evans said that the Piedmont dam was one of the first jobs on which large rubber tires were used. The increased flotation allowed speeds so much higher than the steel-wheeled equipment then used, that some observers thought a "souped-up" tractor was being used.

He told of a test made by the Ordnance Department during the wartime rubber shortage to determine the effectiveness of steel wheels. A 38,000-lb crane equipped with steel wheels was pulled over a prepared test area by a D8 tractor. After 10 ft the wheels had sunk to a depth of 10 in. After rubber tires were substituted, the tractor pulled the crane out of the ruts and up a 10 to 15% grade.

Vehicle Owners Urged To Watch Filtering

by J. B. TOMPKINS, Field Editor

BRITISH COLUMBIA Group, Oct. 9 – Automotive gasoline is cheaper in North America (including taxes) than anywhere else in the world. Current scientific distillation processes are responsible, C. Fred Naylor told this meeting. Speaking on "Best Use of Gasoline in Commercial Vehicles," he cautioned commercial vehicle owners to pay more attention to filtering in storage tanks, since gasoline used in their units must pass through five separate containers between the storage tank and carburetor.

Naylor is acting manager of the Seattle Division of Ethyl Corp., and Northwest Section's reception committee chairman. Answering questions from members during the discussion period, he brought out that:

• Valve failure has nothing to do with valve lubrication;

• Cylinder wear is greatest close to intake valve;

• Water injection was a wartime expedient to drag more horsepower out of an engine without raising cooling capacity of the engine itself. In high horsepowered take-offs, water injection lowers detonation factor in aviation motors. In a truck, this method would have a corrosive effect.

Pittsburgh Members Brave Strike for Brake Meeting

by MURRAY FAHNESTOCK, Field Editor

PITTSBURGH Section, Oct. 22 – Hotel strike notwithstanding, more than 90 members and guests attended Pittsburgh Section's dinner at the University Club tonight, and over 100 heard Stephen Johnson, Jr., assistant sales manager of Bendix-Westinghouse Automotive Air Brake Co., speak on "Braking of Heavy-Duty Vehicles."

Prime considerations in braking automotive vehicles, he said, are first, safety and second, economy. In addition, a satisfactory brake must be reliable, flexible and effective. Reliability depends upon correct design and reasonably good maintenance. Flexibility involves an extension of time in which to obtain predetermined braking forces, and the ability to vary these forces up or down. Effectiveness involves the maximum degree of braking force with flexibility requirements, and reduction of the time required to transmit pneumatic application from tractor cab to rearmost axle.

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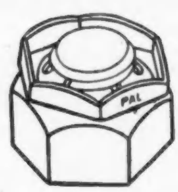
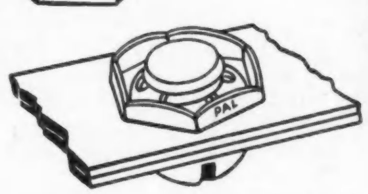


Used as locknut on heavier assemblies



Used alone as self-locking nut on lighter assemblies.

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DOUBLE-LOCKING PALNUTS

Servicing problem was emphasized in discussion following Johnson's paper. It was agreed that factory product is satisfactory, but that the average shop has difficulty in getting surfaces of brake shoes clean and true enough to insure perfect adhesion between lining and shoe. Equipment now developed is doing much to overcome this difficulty.

Com. Ralph Baggaley, Jr., assistant head of diesel engine maintenance, U. S. Navy Bureau of Ships, discussed the relative advantages of quick release on front and rear brakes.

Crosley Engine Is Spotlighted

by HAROLD B. FRYE, Field Editor

CINCINNATI Section, Nov. 11—Paul Klotsch, chief engineer of Crosley Motors, Inc., highlighted the history and manufacture of Crosley engines at this meeting. Technical aspects of their design, engineering and manufacturing methods were clarified by drawings, photographs, and exploded views on slides. During his talk, a complete engine was on display, and after his paper Klotsch showed members an actual block assembly of his engine cut in half in longitudinal section, while he answered questions about performance, construction, and miscellaneous engineering problems.

Economics to Dictate Future Engine Design

by J. E. KLINE, Field Editor

CHICAGO Section, Nov. 12—Economic factors will dictate future engine design, A. T. Colwell told this Section's annual passenger car meeting. Past-President Colwell, vice-president of Thompson Products, Inc., presented his paper on "Powering the Car of the Future." (See SAE Journal, October, 1946.) After Colwell's analysis of trends toward design changes, S. W. Sparrow of Studebaker Corp. pointed out that with increased compression ratios and supercharging, higher friction losses must be expected, so that at road loads expectant gains may not be realized.

Excellence of the meeting was enhanced by the presence of many out-of-town guests and prominent SAE members. Speakers' table, presided over by Section Chairman W. A. Oldacre and Passenger-Car Vice-Chairman H. E. Churchill, included Paul Oberreutter, president of Midwest Dynamometer & Engineering Co.; Section Vice-Chairman W. W. Davies, United Air Lines, Inc.; J. E. Hale, Firestone Tire & Rubber Co., SAE Vice-President representing Passenger Car Activity; Harold Nutt, Borg-Warner Corp.; R. E. Cole, Studebaker Corp.; H. T. Youngren, Ford Motor Co.; Emil Wirth, Bendix Products Corp.; Lee Oldfield, president, Laboratory Equipment Co.; R. E. Cummings, Thompson Products, Inc.; and G. R. Moore, Thompson.

Member Son of Member At Canadian Section

by WARREN HASTINGS, Field Editor

CANADIAN Section, Oct. 16—For the first time in its history, this Section was addressed by a member son of a member father. Speaker Alex L. Gray is vice-president and secretary of Gray Forgings & Stampings, of which Past-Chairman Alex Gray is president. Speaking on "The Steel Fingers of Industry," Gray explained that sockets with their various attachments are the real "steel fingers," backbone of the mechanics' hand tool business. He discussed production problems, materials used, and the economic status of the tool industry.

turn to page 106

Variable Speed Drive Attachment Offers Instant Speed Control for Drill Press Work!

Now you can adjust drill press speeds from high to low—or any intermediate speed—as easily as shifting gears in your car! The Era Variable Speed Drive Attachment enables the operator to provide the correct speed for large or small drills by merely moving a lever. This saving in time results in greater work volume, better work, and lower production cost.

The Era Attachment fits all popular makes of drill presses, and is easily installed without the necessity of drilling holes or changing present equipment.

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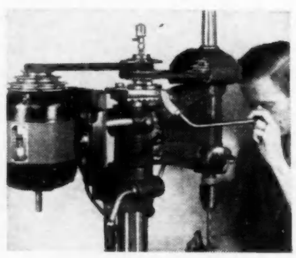
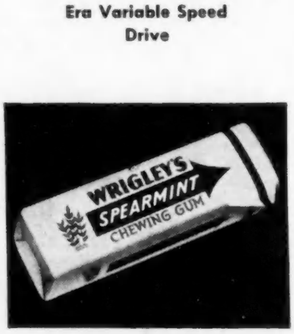


Era Variable Speed Drive



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Art of Precision Grinding Is Ancient and Intricate

by A. M. WATSON, Acting Field Editor

SOUTHERN NEW ENGLAND Section, Nov. 6 – Precision grinding is as old as man, Walter Smith told this meeting; only standards have changed. Thirty years ago, for instance, ± .0005 in. was considered a fine tolerance; today internal grinding is possible to limits within millionths of an inch. Even now, precision work in one industry may not be fine enough for another.

Grinding equipment for the finest precision work must be specially designed and controlled. Air conditioning is essential for the machine, the material, and the gages used. The machine must have working tolerances within its own construction like those to be produced. Cross slide must be graduated in millionths, and must travel in a straight line. There must not be any binding at any point in the mechanism.

Spring-loaded ball bearings are used to maintain a uniform load on the work and allow for different coefficients of expansion. "Mist" lubrication oils the bearings at high spindle speeds. All machine parts must be dynamically balanced to avoid vibration. A deep bed of concrete surrounded by cork prevents outside vibration from affecting the machine.

After the meeting, Smith, who is from Bryant Chucking Grinder Co., answered questions and presented a movie on tooling procedures for internal grinding.

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Highway Engineering Key To Accident Prevention

by WARREN HASTINGS, Field Editor

CANADIAN Section, Sept. 26 – Highway engineering can eliminate most accidents, John D. Millar, Ontario's Deputy Minister of Highways, declared at this meeting. Human element enters largely into side-sweep accidents, but the other three major types of accident – head-on collisions, casualties due to headlight glare, and intersection accidents – can be avoided by sound engineering.

Stressing the interdependence of road and motor vehicle, Millar pointed out that there is little choice transportationally between a good vehicle on a mediocre road and a mediocre vehicle on a good road; hence the importance of Ontario's $600,000,000 investment in roads.

Helicopter Limitations Are Not Insurmountable

by ARNOLD R. OKURO, Field Editor

NEW ENGLAND Section, Oct. 1—Specialized talents have enabled the helicopter to take its place in a competitive market, T. J. Harriman of Bell Aircraft Corp., told this meeting. Its theoretical limitations are restrictive, but do not prevent its doing a large number of useful jobs. Although there is much work to be done on mechanical construction problems, the difficulties are surmountable. The high production gamble has started, he said, and its outcome will determine how widely used and how really practical the helicopter eventually will be.

About SAE Members

cont. from p. 92

Previously division supervisor of motor vehicles **ELTY C. GUIOU** is now motor vehicle supervisor of the New England Telephone & Telegraph Co., Boston.

Presently an industrial engineer,

Johns-Manville Products Corp., Watson, Calif., **GAIL MARVIN STALKER** was a student at New York University.

Formerly development engineer of Baldwin Rubber Co., Pontiac, Mich., **FRED L. HAUSHALTER** is now development engineer for Firestone Industrial Products Co., Akron, Ohio.

Resigning as assistant project engineer of Wright Aeronautical Corp., Wood-Ridge, N. J., **MORTON F. HARRIS** is now project engineer for Marcalus Mfg. Co., East Paterson, N. J.

R. C. HEIDNER has been named chief outboard engineer for West Bend Aluminum Co., Hartford, Wis.

Formerly engineering editor of Automotive & Aviation Industries, Chilton Co., Philadelphia, **R. K. WINKLEBLACK** has become instructor in the mechanical engineering department, University of Missouri, Columbia.

Graduating from the University of Michigan, **WILLIAM DAVID HARSHBARGER** is now a trainee at Westinghouse Electric & Mfg. Co., Pittsburgh.

HARRY I. HAZZARD who was chief engineer of Salisbury Motors, Inc., Los Angeles, is now engineer in charge of industrial engines for McCulloch Aviation, Inc., of the same city.

Previously automotive engineer at Aberdeen Proving Ground, Md., **ROY KAMO** is now doing research work at the Illinois Institute of Technology, Chicago.

GEORGE M. ROZZELL, JR. is now affiliated with Curtiss-Wright Corp., Columbus, Ohio, as junior engineer.

Formerly with Ingersoll-Rand Co., Phillipsburg, N. J., **J. P. VAN OVERVEEN** is now an engineer for Estes Co., New York.

Having returned to civilian life, after serving as aircraft engineering officer in the U. S. Navy, **WALTER C. WALLING** is now wind tunnel test engineer for the NACA at Moffett Field, Calif.

Previously motor rebuilding leadmen with Consolidated Freightways, Inc., Portland, Ore., **KENNETH W. SELF** has become shop superintendent of the same company in Spokane, Wash.

Now manager of the service division, Wisconsin Magneto Co., Milwaukee, **REUBEN J. CORY** was field engineer of the Square D Co., of the same city.

Formerly service & parts department manager, Lewis Motors Co., Seattle, Wash., **WILLIAM F. DUNLOP** is now associated with Nash-Kelvinator Corp., also of Seattle.

Resigning as process engineer of the Carbide & Carbon Chemicals Corp., Oak Ridge, Tenn., **JAMES THOMAS BOWLING** is now engineer for Continental Aviation & Engineering Corp., Detroit.

WILLIAM W. HENNING has been made engineer in charge of product development for International Harvester Co., Melrose Park, Ill.

Having left the Cater Motor Freight, Spokane, Wash., **ALBERT H. CLARK** has become manager and co-owner of Farnsworth Garage, also of Spokane.

AIR BRIG.-GEN. IVAN CARPENTER FERREIRA has been appointed air attache to the Brazilian Embassy, Washington, D. C.

Serving during the war as a machinery and hull repair officer in the U. S. Navy, **ALLAN L. JONES** is design engineer for Shaffer Tool Works, Santa Fe Springs, Calif. The company manufactures fishing and oil field equipment.

Formerly assistant general manager, **ASHTON K. STONE** has been named technical director of Radbill Oil Co., Philadelphia.

Since his release from the U. S. Navy, **ARNOLD B. MEDBERY** has become a student in mechanical engineering at Rensselaer Polytechnic Institute.

Another factor making possible the presentation of PROVED Atwood Clutches of advanced design is the modern, fully equipped testing and research laboratory. New advancements constantly being developed with the aid of these research facilities further emphasize the Atwood challenge in the clutch building field.

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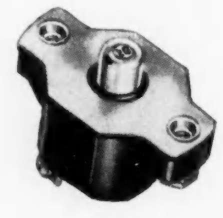
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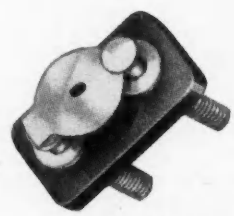
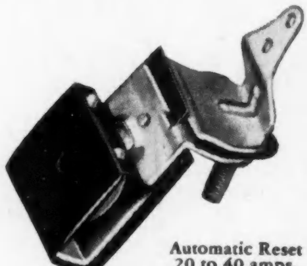
5 to 40 amps.


Automatic Reset
(Weatherproof)
15 to 40 amps.


Automatic Reset
10 to 35 amps.
12 V.D.C. max.


Manual Reset
(Weatherproof)
35 to 150 amps.


Automatic Reset
35 to 150 amps.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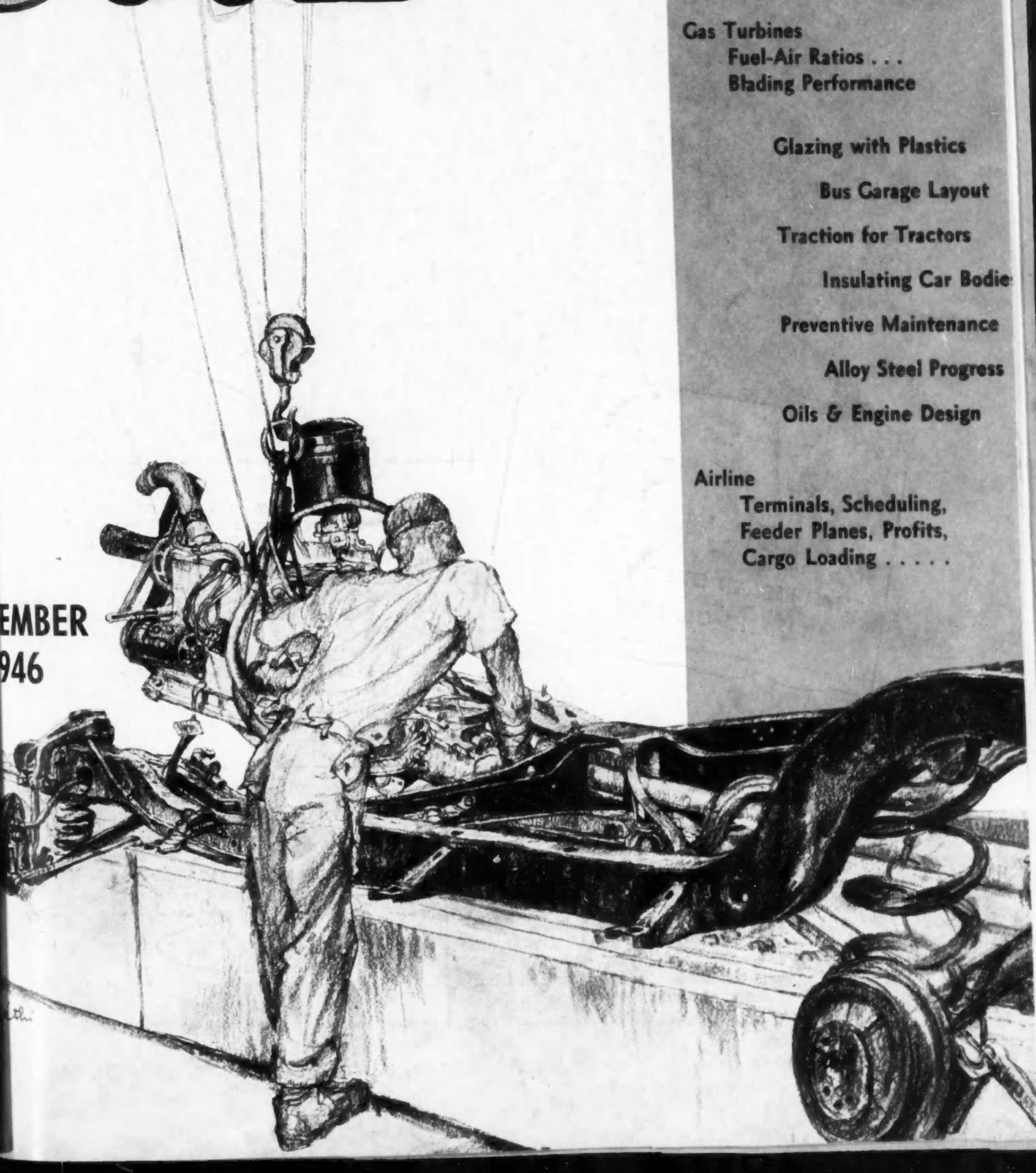

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To find out how much might be saved on the tubular parts you make, why not talk to a member of the Timken Technical Staff. He is thoroughly familiar with the methods and techniques used in the Timken Roller Bearing factories — world's largest users of seamless mechanical tubing. He will gladly make a Job Analysis of your machining problem, then work with your own production people in producing the job on your present equipment to secure maximum savings with top quality of the finished part. And that quality of the finished part is *better*. Write today.

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